BMP
Retrofit
Pilot Program

January 19, 1999 (Approved)
June 15, 2000 (Revised)

BASIS OF DESIGN REPORT DRAINAGE DESIGN, DISTRICT 11 PROCUREMENT

Interstate 5/Manchester Avenue Extended Detention Basin

Caltrans Report ID #: CTSW-RT-98-52-A1

Prepared For:

California Department of Transportation
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ACRONYMS

AES	Advanced Engineering Software
ac	Acre
acft	Acre feet
APC	Alternative Pipe Culvert
BMP	Best Management Practice
Caltrans	California Department of Transportation
cfs	cubic feet per second
CMP	corrugated metal pipe
GMP	Caltrans Inlet Type
NRDC	Natural Resources Defense Council
PS&E	Plans, Specifications, and Estimates
RCP	reinforced concrete pipe

1.0 Introduction

1.1 General

Pursuant to the District 7 Stipulation and District 11 Consent Decree, a BMP Retrofit Pilot Program is required to investigate the effectiveness and appropriateness of retrofitting Caltrans facilities with selected Best Management Practices (BMPs). This report documents the design parameters associated with the implementation of Best Management Practices for storm water discharges at one Caltrans District 11 site to satisfy the requirements of the Stipulation and Constent Decree. Siting information for the location is provided in the report entitled, "BMP Retrofit Pilot Program, Composite Siting Study, District 11" dated May 26, 1998, by Robert Bein, William Frost & Associates. The BMP Pilot Project discussed in this report is an extended detention basin.

1.2 Objectives

The purpose of this study is to provide design criteria and information in support of the construction drawings of the BMP Retrofit Pilot Program project. Specifically, the objectives of this report are as follows:

- Define hydrologic criteria for the design of the BMP.
- Develop discharges for the design conditions.
- Define hydraulic criteria for the design of the BMP.
- Define design parameters for the BMP.
- Provide technical calculations supporting the drainage facility designs shown on the construction drawings.

1.3 Project Locations

Project and site reference numbers are as indicated in the program *Scoping Study*, dated May 22, 1998 and *Status Report #1,* dated March 30, 1998.

1.3.1 Project 1, Site2: Northbound I-5/Manchester Avenue Extended Detention Basin

The BMP Retrofit Pilot Project at Site 2 is an extended detention basin located at the NB I-5/Manchester Avenue intersection in the City of Encinitas. The basin is located in the area bounded by the I-5 northbound mainline to the west, I-5 northbound offramp to the north and east and Manchester Avenue to the south.

1.4 Construction Costs

The estimated cost of construction for the site is $305,301. A copy of the Engineer's Estimate is included in Appendix E.

2.0 HYDROLOGIC CHARACTERISICS

2.1 Rainfall Characteristics

San Diego County has a Mediterranean-type climate characterized by long, dry summers and mild winters. The average annual precipitation is about 12 inches and increases to about 18 inches in elevations above 2000 feet. Most of the precipitation occurs from November through March, with little or no rainfall from May through October. The average rainfall depth, calculated using the rainfall obtained from the Averaged Mass Rainfall Plotting Sheets (Appendix A), for a 1-year, 24-hour storm is 1.26 inches.

2.2 Soil Types and Infiltration

Based on the U.S. Soil Conservation Services criteria, soils are classified into four hydrological soil groups: A, B, C, and D, where A is the most pervious with low runoff potential (such as sand or gravel) and D is the least pervious with high runoff potential (such as clay soils).

2.3 Methodology and Procedure

a. The County of San Diego Department of Public Works, Flood Control Division Hydrology Manual, dated January 5, 1985 provides the procedure used for hydrologic computations.
b. Hydrologic calculations were performed using the Advanced Engineering Software (AES) Rational Method computer program for the 6-month, 1-year, and 25-year design storms.
c. Rainfall intensities were obtained from the isohyetals provided in the hydrology manual. The 6-month and 1-year 24-hour storms were extrapolated from the 2-year, 24-hour and 6-hour isohyetals. (See Appendix A.)
d. The unit hydrograph procedure was used to compute storm water runoff volumes. User specified rainfall-intensity data was determined by plotting the 6-month, and 1-year, 24-hour storm data on a mass rainfall plotting sheet. The data pairs were then selected and input into the AES Small Area Unit Hydrograph Modeling computer program.

2.4 Summary of Results

The hydrology map for the site is located in Appendix C. The hydrology map delineates the tributary areas for drainage to the BMP Retrofit site. Appendix A contains the result of the AES hydrologic calculations for the site identified in this report.

3.0 WATER QUALITY DESIGN DISCUSSION AND ASSUMPTIONS

3.1 Project 1, Site 2: Northbound I-5/Manchester Avenue Extended Detention Basin

The pilot is an off-line, earthen, extended detention basin with a tributary area that includes mainline freeway, an offramp and some limited adjacent slope areas for a total tributary area of 4.8 acres. Inflow to the basin occurs at a single point, the total computed 1-year, 24-hour water quality design volume is 0.20 acre-feet. Flow is discharged through a series of orifices cut into the wall of the riser outlet. The orifices were set at two stages; the 6-month at the basin invert and the 1-year, at the 6-month water surface elevation. The resulting orifice diameters and elevation relative to the basin invert are shown in the Table 1 below. The orifice calculations are located in Appendix B.

Table 1

Storm frequency	*Number of orifices*	*Orifice Diameter (in)*	*Orifice Invert (ft)*
6-month	2	0.73	0
1-year	2	0.61	1.92

A debris screen (¼" openings) protects the orifices from clogging as well as providing a 1-foot wide, 180° clear zone flow path. The rim of the riser was set at the 1-year, 24-hour storage elevation. Less frequent storms will discharge through the top of the riser. A concrete spillway was provided to pass higher flows and to provide a secondary outlet. The area surrounding the basin which is disturbed during construction will be stabilized to reduce erosion potential using a hydroseed mix as indicated in the project specifications, Design Directive Memorandum No. 6, and page three of the planting recommendations by Martha Blane & Associates, dated May 12, 1998 (Appendix D.)

Maintenance access is provided at the perimeter of the basin. Storm water samples will be taken using automated equipment at both the basin inflow and outflow points. The discharge to the basin outlets onto a grouted riprap pad, which serves to reduce the outlet velocity and spread the flow. The basin has an average L:W ratio of 3:1.

The basin was designed as an offline facility to capture the tributary watershed for water quality purposes. A canal gate at the basin invert is provided to drain the basin should clogging of the orifices occur. A 30-foot clear zone setback to adjacent ramp and the freeway mainline was maintained adjacent to the basin. A concrete driveway was provided to access the maintenance road located at the perimeter of the basin. Basin side slopes are 1:4. The design residence time is 72-hours for the 6-month and 1-year storm frequency. Water depths are 1.92 feet and 2.73 feet respectively.

3.1.1 Tributary Drainage Area

The location selected for the Pilot Project is an infield area bounded by existing Caltrans ramps and freeway mainline. The water quality runoff tributary to the BMP was either diverted or rerouted to the basin by way of a new storm drain system. The tributary areas for drainage to the BMP Retrofit site are delineated on the hydrology map located in Appendix C. Diverted runoff includes 2.2 acres from the northbound I-5 mainline. An area of approximately 1.3 acres (areas A3, A4, and A5 on the hydrology map) from the southerly approach slab of the Manchester Avenue overcrossing to the existing northbound AC overside drain is tributary to an existing catch basin connected to an existing 24 inch RCP cross culvert which discharges to the southbound onramp infield. The existing catch basin is proposed to be replaced with a deeper inlet structure. The new inlet will be connected to a new 18 inch APC to divert the design storm to the basin. The invert of the new pipe will be lower than the existing pipe. A restrictor plate will be connected to the inlet wall at the entrance of the 18 inch pipe to limit the diverted discharge to the basin to the design flow. The existing 24 inch RCP will be connected to the new inlet to discharge the less frequent storms to the southbound onramp infield, maintaining the existing flowpath for larger storm events. An area of approximately 0.9 acres (areas A1 and A2) southerly from the northbound I-5 onramp gore is tributary to an existing AC overside drain. The runoff is captured by the overside drain and is conveyed by an earth swale to an existing riser at the northbound onramp/offramp nose. The runoff is then conveyed through an existing 24 inch RCP that discharges to a concrete channel adjacent to the northbound onramp along the easterly Caltrans right-of-way. A new inlet and 24 inch APC will be placed within the existing AC overside drain to capture the design storm. A restrictor plate will be connected to the inlet wall at the entrance of the 24 inch pipe to restrict the discharge to the basin to the design flow. Flows exceeding the design storm will discharge to the existing riser. The rerouted runoff includes approximately 0.6 acres (areas A7 and A8) from the northbound offramp and is tributary to the existing 18 inch RCP located at the Manchester Avenue intersection. A new inlet and 18 inch APC will intercept the flow from the ramp shoulder and convey it to the basin. The infield runoff, approximately 2.0 acres (area A6), is tributary to an existing 18 inch CMP at an existing sump in the southerly portion of the infield area. A new concrete channel will intercept the infield runoff and convey it the basin. The total tributary area to the basin is 4.8 acres.

The offramp and infield tributary areas discharge to the San Elijo Lagoon via an existing 24 inch RCP that crosses Manchester Avenue. The existing culvert was not sized to receive additional storm flows other than those currently draining to the proposed basin location.

Additional drainage area within the Caltrans right-of-way could be diverted to the proposed extended detention basin location by modifying the site to provide: 1) a water quality diversion drainage system within the northbound shoulder north of the northbound onramp, 2) removing several large trees on the site to increase the basin surface area and 3) an upgrade to the existing outflow pipe under Manchester Avenue. The cost to divert the additional runoff was estimated to be $240,600. Table 2 itemizes the costs to route an approximate additional 1.6 acres of mainline and 3 acres of vegetated slope runoff (Area X1 on the hydrology map), via a 24 inch storm drain,

to the BMP site. The following changes to the storm drain system (within Caltrans right-of-way) would be required:

Table 2

Description	Quantity	Unit Price	Total Cost
Mainline Shoulder and On Ramp Closure	1 ea	$50,000	$50,000
Inlet	6 ea	$500	$3,000
Headwall	1 ea	$2,500	$2,500
18” Storm Drain	1,200 lf	$90	$108,000
24” Storm Drain	100 lf	$100	$10,000
Tree Removal	6 ea	$1,000	$6,000
Tree Replacement 3:1 Mitigation Ratio	18 ea	$500	$9,000
36” Storm Drain	80 lf	$150	$12,000
		Subtotal	$200,500
		Contingency @ 20%	$40,100
		Total	$240,600

Approximately 4.8 acres (Area X2) of runoff from the southbound I-5 mainline could theoretically be re-routed to the proposed BMP basin. This would involve jacking under the northbound and southbound travel lanes of I-5, replacing existing mainline catch basin inlets, and upgrading the downstream drainage facilities located in Manchester Avenue at a cost of approximately $333,600. Table 3 itemizes the costs to route an approximate additional 4.8 acres to the BMP site and upgrade the downstream drainage facilities. In addition, several mature eucalyptus trees would be removed to enlarge the basin.

Table 3

Description	Quantity	Unit Price	Total Cost
Jacking Pit	1 ea	$50,000	$50,000
Receiving Pit	1 ea	$50,000	$50,000
Jacked Pipe	300 lf, 24” RCP	$450	$135,000
Headwall	1 ea	$2,500	$2,500
Replace Catch Basin	3 ea	$1,500	$4,500
Downstream Upgrade	180 lf, 48” RCP	$200	$36,000
		Subtotal	$278,000
		Contingency @ 20%	$55,600

		Total	$333,600

Due to the relatively high marginal cost of bringing additional tributary area to the site, these options were not pursued.

3.1.2 Siting Constraints

The primary constraints on siting of the basin were to 1) maintain a 30-foot clear zone setback from all highway and mainline freeways, and ramps 2) provide suitable maintenance ingress and egress, 3) minimize site impacts (removal and substitution of existing eucalyptus and pepper trees) due to the coastal development regulations, and 4) avoid the existing Cardiff Sanitation District pumpstation and overflow pond. The basin depth was constrained by the existing ground water elevation and the hydraulics of the inflow pipe due to the grade separation between the offramp and the minimum basin invert. The initial design for this site required a concrete lined basin to mitigate the high groundwater table (11.84 ft on December 15, 1998). The concrete lining in the current basin was eliminated by raising the invert 3 feet to achieve a minimum ground water separation of 2 feet (ground water elevation, 13.0 ft on December 15, 1998). The groundwater elevation will be monitored until construction of the site commences. Since the offramp lateral (Drainage System 21, unit i of the construction plans) could not be relocated without reducing the area tributary to the BMP, the basin depth relative to the existing grade was also fixed. Further, expanding the basin area northerly is not practical due to the removal of trees required for grading. The site is constrained to the west by the existing freeway mainline and northbound offramp embankment. In general, the site is suitable for retrofit of an extended detention basin and has acceptable maintenance access.

4.0 HYDRAULIC ANALYSIS –

4.1 Design Criteria

Technical references include the Caltrans Highway Design Manual (Caltrans 1997), and the Caltrans Storm Water Quality Handbook, Planning and Design Staff Guide (Caltrans 1996) and the project *Scoping Study*.

4.2 Methodology and Design Procedures

a. The inlet capacity for the GCP and modified GMP inlets with debris rack cages over the top of the inlet was calculated using “Figure 6.1-5: Circular Riser Inflow Curves”, from the U.S. Department of Agriculture.
b. The orifice opening was calculated using the orifice equation cited in the Caltrans Storm Water Quality Handbook, Planning and Design Staff Guide.

c. Full pond design drawdown time is 72-hours.
d. The outlet riser and spillway are designed to take the maximum discharge tributary to the basin during a 25-year rainfall event.

4.3 Summary of Results

The extended detention basin has been designed as an offline device. The peak water quality inflow volume will be directed to the basin, the portion of the storm with a peak discharge in excess of the 1-year 24-hour storm will be conveyed though the existing storm drain facilities, thereby minimizing the surcharge to the water quality inflow system and BMP. Hydraulic calculations are provided in Appendix B. A riser will control the water quality outflow to achieve the desired average detention time of 24-hours. Storm events greater than the one year water quality volume will receive less attenuation, spilling directly to the riser outlet.

REFERENCES

BMP Retrofit Pilot Program, Composite Siting Study, District 11 prepared by Robert Bein, William Frost and Associates. May 26, 1998.

BMP Retrofit Pilot Program, Scoping Study, Caltrans District 11 prepared by Robert Bein, William Frost and Associates. May 22, 1998.

California Department of Transportation (Caltrans), *Highway Design Manual.* Fifth Edition. March 1997.

Caltrans Storm Water Quality Handbook, Planning and Design Staff Guide (Caltrans 1996).

County of San Diego, Department of Public Works, Flood Control Division, Hydrology Manual. January 1985.

Pre-Construction Geotechnical Evaluation Report, Caltrans Storm Water Runoff Study, Retrofit Facilities, District 11, Extended Detention Basin, Manchester East, San Diego County California, prepared by Group Delta Consultants, Inc. January 11, 1999.

Walesh, Stuart G., *Urban Surface Water Management,* John Wiley & Sons, Inc, New York, 1989.

APPENDIX A
HYDROLOGY CALCULATIONS

ELEV.	FACTOR
0–1500	1.00
1500–3000	1.25
3000–4000	1.42
4000–5000	1.60
5000–6000	1.70
DESERT	1.25

To obtain correct intensity, multiply intensity on chart by factor for design elevation.

RAINFALL

INTENSITY – DURATION – FREQUENCY

CURVES

for

COUNTY OF SAN DIEGO

APPENDIX XI

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          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                     1985,1981 HYDROLOGY MANUAL
       (c) Copyright 1982-96 Advanced Engineering Software (aes)
          Ver. 1.5A  Release Date: 01/01/96  License ID 1264

                        Analysis prepared by:

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                          Irvine, CA  92618
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 ************************** DESCRIPTION OF STUDY **************************
* JN34358 I-5/MANCHESTER AVE EXTENDED DETENTION BASIN   *
* 6-MONTH STORM FREQUENCY, WATER QUALITY VOLUME   *
* AMW   *
 ****

  FILE NAME: I5MAN6M.DAT
  TIME/DATE OF STUDY: 17:43   1/12/1999

  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

  USER SPECIFIED STORM EVENT(YEAR) =   1.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) = 18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = .95
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS = 9
   1)   5.000; 1.550
   2) 10.000; 1.140
   3) 20.000;   .780
   4) 30.000;   .600
   5) 40.000;   .500
   6) 50.000;   .435
   7) 60.000;   .385
   8) 120.000;   .248
   9) 180.000;   .188
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED

****
  FLOW PROCESS FROM NODE   1.00 TO NODE   2.00 IS CODE = 21

  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==
  SOIL CLASSIFICATION IS "B"
  INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
  INITIAL SUBAREA FLOW-LENGTH =   300.00
  UPSTREAM ELEVATION =   57.50
  DOWNSTREAM ELEVATION =   48.82
  ELEVATION DIFFERENCE =   8.68
  URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =   5.470
  *CAUTION: SUBAREA SLOPE EXCEEDS COUNTY NOMOGRAPH
   DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.
  TIME OF CONCENTRATION ASSUMED AS 6-MINUTES
     1 YEAR RAINFALL INTENSITY(INCH/HOUR) = 1.468
  SUBAREA RUNOFF(CFS) =   .35
  TOTAL AREA(ACRES) =   .28   TOTAL RUNOFF(CFS) =   .35

****
  FLOW PROCESS FROM NODE   2.00 TO NODE   3.00 IS CODE =   6

  >>>>>COMPUTE STREETFLOW TRAVELTIME THRU SUBAREA<<<<<
==
  UPSTREAM ELEVATION =   48.82   DOWNSTREAM ELEVATION =   38.44
  STREET LENGTH(FEET) =   380.00   CURB HEIGHT(INCHES) = 6.
  STREET HALFWIDTH(FEET) = 58.00
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 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK =  48.00
 INTERIOR STREET CROSSFALL(DECIMAL) =    .020
 OUTSIDE STREET CROSSFALL(DECIMAL)  =    .050

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1

      **TRAVELTIME COMPUTED USING MEAN FLOW(CFS) =      .67
   STREETFLOW MODEL RESULTS:
      STREET FLOWDEPTH(FEET) =    .19
      HALFSTREET FLOODWIDTH(FEET) =    2.16
      AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.32
      PRODUCT OF DEPTH&VELOCITY =      .63
 STREETFLOW TRAVELTIME(MIN) =   1.91   TC(MIN) =   7.91

   1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.312
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 SUBAREA AREA(ACRES) =      .58   SUBAREA RUNOFF(CFS) =      .65
 SUMMED AREA(ACRES) =      .86   TOTAL RUNOFF(CFS) =      1.00
 END OF SUBAREA STREETFLOW HYDRAULICS:
 DEPTH(FEET) =  .23   HALFSTREET FLOODWIDTH(FEET) =  2.96
 FLOW VELOCITY(FEET/SEC.) =  3.28   DEPTH*VELOCITY =     .75


****************************************************************************
 FLOW PROCESS FROM NODE      3.00 TO NODE      4.00 IS CODE =   4
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
============================================================================
 DEPTH OF FLOW IN  24.0 INCH PIPE IS   1.7 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   9.7
 UPSTREAM NODE ELEVATION =    38.44
 DOWNSTREAM NODE ELEVATION =    29.94
 FLOWLENGTH(FEET) =    47.23   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      1.00
 TRAVEL TIME(MIN.) =    .08    TC(MIN.) =   7.99


****************************************************************************
 FLOW PROCESS FROM NODE      4.00 TO NODE      4.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =   7.99
 RAINFALL INTENSITY(INCH/HR) =   1.31
 TOTAL STREAM AREA(ACRES) =      .86
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.00


****************************************************************************
 FLOW PROCESS FROM NODE     10.00 TO NODE     11.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 INITIAL SUBAREA FLOW-LENGTH =   300.00
 UPSTREAM ELEVATION =     41.79
 DOWNSTREAM ELEVATION =     36.61
 ELEVATION DIFFERENCE =      5.18
 URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =    6.497
   1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.427
 SUBAREA RUNOFF(CFS) =       .36
 TOTAL AREA(ACRES) =       .30   TOTAL RUNOFF(CFS) =       .36


****************************************************************************
 FLOW PROCESS FROM NODE     11.00 TO NODE     12.00 IS CODE =   6
----------------------------------------------------------------------------
 >>>>>COMPUTE STREETFLOW TRAVELTIME THRU SUBAREA<<<<<
============================================================================
```

```
 UPSTREAM ELEVATION =     36.61   DOWNSTREAM ELEVATION =     35.40
 STREET LENGTH(FEET) =   200.00   CURB HEIGHT(INCHES) = 6.
 STREET HALFWIDTH(FEET) = 68.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK =  10.00
 INTERIOR STREET CROSSFALL(DECIMAL) =   .020
 OUTSIDE STREET CROSSFALL(DECIMAL)  =   .020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1

       **TRAVELTIME COMPUTED USING MEAN FLOW(CFS) =     .53
   STREETFLOW MODEL RESULTS:
       STREET FLOWDEPTH(FEET) =   .23
       HALFSTREET FLOODWIDTH(FEET) =    5.40
       AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.30
       PRODUCT OF DEPTH&VELOCITY =     .30
 STREETFLOW TRAVELTIME(MIN) =   2.57   TC(MIN) =   9.07

    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.216
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 SUBAREA AREA(ACRES) =     .32   SUBAREA RUNOFF(CFS) =     .33
 SUMMED AREA(ACRES) =     .62   TOTAL RUNOFF(CFS) =       .69
 END OF SUBAREA STREETFLOW HYDRAULICS:
 DEPTH(FEET) =  .24   HALFSTREET FLOODWIDTH(FEET) =  5.92
 FLOW VELOCITY(FEET/SEC.) =  1.48   DEPTH*VELOCITY =    .36


****************************************************************************
 FLOW PROCESS FROM NODE    12.00 TO NODE    12.00 IS CODE =   8
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.216
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 SUBAREA AREA(ACRES) =     .65   SUBAREA RUNOFF(CFS) =     .67
 TOTAL AREA(ACRES) =     1.27   TOTAL RUNOFF(CFS) =    1.37
 TC(MIN) =   9.07


****************************************************************************
 FLOW PROCESS FROM NODE    12.00 TO NODE     4.00 IS CODE =   4
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
============================================================================
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   3.8 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   5.1
 UPSTREAM NODE ELEVATION =    35.40
 DOWNSTREAM NODE ELEVATION =    29.94
 FLOWLENGTH(FEET) =   290.00   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      1.37
 TRAVEL TIME(MIN.) =    .96    TC(MIN.) =  10.02


****************************************************************************
 FLOW PROCESS FROM NODE     4.00 TO NODE     4.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =  10.02
 RAINFALL INTENSITY(INCH/HR) =   1.14
 TOTAL STREAM AREA(ACRES) =    1.27
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.37

 ** CONFLUENCE DATA **
 STREAM      RUNOFF       Tc       INTENSITY      AREA
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)    (ACRE)
    1          1.00      7.99       1.305          .86
    2          1.37     10.02       1.139         1.27
```

```
 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
 STREAM     RUNOFF      Tc       INTENSITY
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
    1         2.19     7.99      1.305
    2         2.24    10.02      1.139

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      2.24   Tc(MIN.) =   10.02
 TOTAL AREA(ACRES) =      2.13


****************************************************************************
 FLOW PROCESS FROM NODE     4.00 TO NODE     4.00 IS CODE =   8
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.139
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 SUBAREA AREA(ACRES) =     .05   SUBAREA RUNOFF(CFS) =     .05
 TOTAL AREA(ACRES) =     2.18   TOTAL RUNOFF(CFS) =    2.28
 TC(MIN) =  10.02


****************************************************************************
 FLOW PROCESS FROM NODE     4.00 TO NODE     5.00 IS CODE =   4
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
============================================================================
 DEPTH OF FLOW IN  24.0 INCH PIPE IS   3.2 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   9.0
 UPSTREAM NODE ELEVATION =    29.94
 DOWNSTREAM NODE ELEVATION =    18.94
 FLOWLENGTH(FEET) =   158.20   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      2.28
 TRAVEL TIME(MIN.) =     .29    TC(MIN.) =  10.32


****************************************************************************
 FLOW PROCESS FROM NODE     5.00 TO NODE     6.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION =     18.94
 DOWNSTREAM NODE ELEVATION =     17.48
 CHANNEL LENGTH THRU SUBAREA(FEET) =   235.73
 CHANNEL SLOPE =   .0062
 CHANNEL BASE(FEET) =    2.46   "Z" FACTOR =   1.500
 MANNING'S FACTOR =  .015   MAXIMUM DEPTH(FEET) =    .72
 CHANNEL FLOW THRU SUBAREA(CFS) =      2.28
 FLOW VELOCITY(FEET/SEC) =   2.93   FLOW DEPTH(FEET) =    .27
 TRAVEL TIME(MIN.) =   1.34   TC(MIN.) =  11.66


****************************************************************************
 FLOW PROCESS FROM NODE     6.00 TO NODE     6.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =  11.66
 RAINFALL INTENSITY(INCH/HR) =   1.08
 TOTAL STREAM AREA(ACRES) =    2.18
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.28


****************************************************************************
```

```
 FLOW PROCESS FROM NODE    20.00 TO NODE    21.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 INITIAL SUBAREA FLOW-LENGTH =   300.00
 UPSTREAM ELEVATION =     39.71
 DOWNSTREAM ELEVATION =     34.46
 ELEVATION DIFFERENCE =      5.25
 URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =    6.468
   1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.430
 SUBAREA RUNOFF(CFS) =       .18
 TOTAL AREA(ACRES) =       .15   TOTAL RUNOFF(CFS) =       .18


****************************************************************************
 FLOW PROCESS FROM NODE    21.00 TO NODE    22.00 IS CODE =   6
----------------------------------------------------------------------------
 >>>>>COMPUTE STREETFLOW TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM ELEVATION =     34.46   DOWNSTREAM ELEVATION =     18.24
 STREET LENGTH(FEET) =   505.00   CURB HEIGHT(INCHES) = 6.
 STREET HALFWIDTH(FEET) = 22.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK =  20.00
 INTERIOR STREET CROSSFALL(DECIMAL) =   .030
 OUTSIDE STREET CROSSFALL(DECIMAL)  =   .030

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1

       **TRAVELTIME COMPUTED USING MEAN FLOW(CFS) =     .39
   STREETFLOW MODEL RESULTS:
       STREET FLOWDEPTH(FEET) =   .16
       HALFSTREET FLOODWIDTH(FEET) =    1.50
       AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.38
       PRODUCT OF DEPTH&VELOCITY =     .53
 STREETFLOW TRAVELTIME(MIN) =   2.49   TC(MIN) =   8.96

   1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.225
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 SUBAREA AREA(ACRES) =     .39   SUBAREA RUNOFF(CFS) =     .41
 SUMMED AREA(ACRES) =     .54   TOTAL RUNOFF(CFS) =       .59
 END OF SUBAREA STREETFLOW HYDRAULICS:
 DEPTH(FEET) =  .19   HALFSTREET FLOODWIDTH(FEET) =  2.46
 FLOW VELOCITY(FEET/SEC.) =  2.98   DEPTH*VELOCITY =     .55


****************************************************************************
 FLOW PROCESS FROM NODE    22.00 TO NODE     6.00 IS CODE =   4
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
============================================================================
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   2.4 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   4.1
 UPSTREAM NODE ELEVATION =    18.24
 DOWNSTREAM NODE ELEVATION =    17.48
 FLOWLENGTH(FEET) =    35.00   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =       .59
 TRAVEL TIME(MIN.) =    .14    TC(MIN.) =   9.10


****************************************************************************
 FLOW PROCESS FROM NODE     6.00 TO NODE     6.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   9.10
 RAINFALL INTENSITY(INCH/HR) =   1.21
```

```
 TOTAL STREAM AREA(ACRES) =      .54
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       .59

 ** CONFLUENCE DATA **
 STREAM      RUNOFF       Tc       INTENSITY       AREA
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)     (ACRE)
    1          2.28     11.66       1.080          2.18
    2           .59      9.10       1.214           .54

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
 STREAM      RUNOFF       Tc       INTENSITY
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)
    1          2.62      9.10       1.214
    2          2.81     11.66       1.080

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      2.81   Tc(MIN.) =   11.66
 TOTAL AREA(ACRES) =      2.72


****************************************************************************
 FLOW PROCESS FROM NODE      6.00 TO NODE      6.00 IS CODE =   8
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.080
 SOIL CLASSIFICATION IS "B"
 RURAL DEVELOPMENT RUNOFF COEFFICIENT = .3500
 SUBAREA AREA(ACRES) =     1.97   SUBAREA RUNOFF(CFS) =      .74
 TOTAL AREA(ACRES) =      4.69   TOTAL RUNOFF(CFS) =     3.55
 TC(MIN) =  11.66


****************************************************************************
 FLOW PROCESS FROM NODE      6.00 TO NODE      7.00 IS CODE =   4
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
============================================================================
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   4.6 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =  10.0
 UPSTREAM NODE ELEVATION =    17.48
 DOWNSTREAM NODE ELEVATION =    15.00
 FLOWLENGTH(FEET) =    41.49   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      3.55
 TRAVEL TIME(MIN.) =     .07    TC(MIN.) =  11.73


****************************************************************************
 FLOW PROCESS FROM NODE      7.00 TO NODE      7.00 IS CODE =   8
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.078
 SOIL CLASSIFICATION IS "B"
 SINGLE FAMILY DEVELOPMENT RUNOFF COEFFICIENT = .4500
 SUBAREA AREA(ACRES) =      .14   SUBAREA RUNOFF(CFS) =      .07
 TOTAL AREA(ACRES) =      4.83   TOTAL RUNOFF(CFS) =     3.62
 TC(MIN) =  11.73
============================================================================
 END OF STUDY SUMMARY:
 PEAK FLOW RATE(CFS) =      3.62   Tc(MIN.) =   11.73
 TOTAL AREA(ACRES) =      4.83
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************

           RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                     1985,1981 HYDROLOGY MANUAL
        (c) Copyright 1982-96 Advanced Engineering Software (aes)
           Ver. 1.5A  Release Date: 01/01/96  License ID 1264

                        Analysis prepared by:

              Robert Bein, William Frost & Associates
                        14725 Alton Parkway
                         Irvine, CA  92618
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 ************************** DESCRIPTION OF STUDY *************************
 * JN34358 I-5/MANCHESTER AVE EXTENDED DETENTION BASIN   *
 * 1-YR STORM FREQUENCY, WATER QUALITY VOLUME   *
 * AMW   *
 ****

  FILE NAME: I5MAN1Y.DAT
  TIME/DATE OF STUDY: 17:17   1/12/1999

  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

  USER SPECIFIED STORM EVENT(YEAR) =   1.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) = 18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = .95
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS = 9
   1)   5.000; 1.950
   2) 10.000; 1.430
   3) 20.000;   .960
   4) 30.000;   .770
   5) 40.000;   .630
   6) 50.000;   .545
   7) 60.000;   .480
   8) 120.000;   .320
   9) 180.000;   .235
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED

****
  FLOW PROCESS FROM NODE   1.00 TO NODE   2.00 IS CODE = 21

  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==
  SOIL CLASSIFICATION IS "B"
  INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
  INITIAL SUBAREA FLOW-LENGTH =   300.00
  UPSTREAM ELEVATION =   57.50
  DOWNSTREAM ELEVATION =   48.82
  ELEVATION DIFFERENCE =   8.68
  URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =   5.470
  *CAUTION: SUBAREA SLOPE EXCEEDS COUNTY NOMOGRAPH
   DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.
  TIME OF CONCENTRATION ASSUMED AS 6-MINUTES
     1 YEAR RAINFALL INTENSITY(INCH/HOUR) = 1.846
  SUBAREA RUNOFF(CFS) =   .44
  TOTAL AREA(ACRES) =   .28   TOTAL RUNOFF(CFS) =   .44

****
  FLOW PROCESS FROM NODE   2.00 TO NODE   3.00 IS CODE =   6

  >>>>>COMPUTE STREETFLOW TRAVELTIME THRU SUBAREA<<<<<
==
  UPSTREAM ELEVATION =   48.82 DOWNSTREAM ELEVATION =   38.44
  STREET LENGTH(FEET) =   380.00 CURB HEIGHT(INCHES) = 6.
  STREET HALFWIDTH(FEET) = 58.00
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```

```
 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK =  48.00
 INTERIOR STREET CROSSFALL(DECIMAL) =    .020
 OUTSIDE STREET CROSSFALL(DECIMAL)  =    .050

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1

      **TRAVELTIME COMPUTED USING MEAN FLOW(CFS) =      .85
  STREETFLOW MODEL RESULTS:
      STREET FLOWDEPTH(FEET) =    .22
      HALFSTREET FLOODWIDTH(FEET) =    2.70
      AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.18
      PRODUCT OF DEPTH&VELOCITY =     .69
 STREETFLOW TRAVELTIME(MIN) =   1.99   TC(MIN) =   7.99

   1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.639
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 SUBAREA AREA(ACRES) =     .58   SUBAREA RUNOFF(CFS) =     .81
 SUMMED AREA(ACRES) =     .86   TOTAL RUNOFF(CFS) =     1.25
 END OF SUBAREA STREETFLOW HYDRAULICS:
 DEPTH(FEET) =  .24   HALFSTREET FLOODWIDTH(FEET) =  3.23
 FLOW VELOCITY(FEET/SEC.) =  3.62   DEPTH*VELOCITY =    .88


****************************************************************************
 FLOW PROCESS FROM NODE     3.00 TO NODE     4.00 IS CODE =   4
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
============================================================================
 DEPTH OF FLOW IN  24.0 INCH PIPE IS   1.9 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =  10.4
 UPSTREAM NODE ELEVATION =    38.44
 DOWNSTREAM NODE ELEVATION =    29.94
 FLOWLENGTH(FEET) =    47.23   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      1.25
 TRAVEL TIME(MIN.) =    .08    TC(MIN.) =   8.07


****************************************************************************
 FLOW PROCESS FROM NODE     4.00 TO NODE     4.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =   8.07
 RAINFALL INTENSITY(INCH/HR) =   1.63
 TOTAL STREAM AREA(ACRES) =     .86
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.25


****************************************************************************
 FLOW PROCESS FROM NODE    10.00 TO NODE    11.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 INITIAL SUBAREA FLOW-LENGTH =   300.00
 UPSTREAM ELEVATION =    41.79
 DOWNSTREAM ELEVATION =    36.61
 ELEVATION DIFFERENCE =     5.18
 URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =    6.497
   1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.794
 SUBAREA RUNOFF(CFS) =      .46
 TOTAL AREA(ACRES) =      .30   TOTAL RUNOFF(CFS) =      .46


****************************************************************************
 FLOW PROCESS FROM NODE    11.00 TO NODE    12.00 IS CODE =   6
----------------------------------------------------------------------------
 >>>>>COMPUTE STREETFLOW TRAVELTIME THRU SUBAREA<<<<<
============================================================================
```

```
 UPSTREAM ELEVATION =     36.61   DOWNSTREAM ELEVATION =     35.40
 STREET LENGTH(FEET) =   200.00   CURB HEIGHT(INCHES) = 6.
 STREET HALFWIDTH(FEET) = 68.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK =  10.00
 INTERIOR STREET CROSSFALL(DECIMAL) =    .020
 OUTSIDE STREET CROSSFALL(DECIMAL)  =    .020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1

      **TRAVELTIME COMPUTED USING MEAN FLOW(CFS) =     .67
   STREETFLOW MODEL RESULTS:
      STREET FLOWDEPTH(FEET) =   .24
      HALFSTREET FLOODWIDTH(FEET) =    5.92
      AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.42
      PRODUCT OF DEPTH&VELOCITY =     .35
 STREETFLOW TRAVELTIME(MIN) =   2.34   TC(MIN) =   8.84

   1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.551
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 SUBAREA AREA(ACRES) =     .32   SUBAREA RUNOFF(CFS) =     .42
 SUMMED AREA(ACRES) =     .62   TOTAL RUNOFF(CFS) =      .88
 END OF SUBAREA STREETFLOW HYDRAULICS:
 DEPTH(FEET) =  .27   HALFSTREET FLOODWIDTH(FEET) =  6.96
 FLOW VELOCITY(FEET/SEC.) =  1.46   DEPTH*VELOCITY =    .39


****************************************************************************
 FLOW PROCESS FROM NODE    12.00 TO NODE    12.00 IS CODE =   8
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.551
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 SUBAREA AREA(ACRES) =     .65   SUBAREA RUNOFF(CFS) =     .86
 TOTAL AREA(ACRES) =     1.27   TOTAL RUNOFF(CFS) =    1.74
 TC(MIN) =   8.84


****************************************************************************
 FLOW PROCESS FROM NODE    12.00 TO NODE     4.00 IS CODE =   4
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
============================================================================
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   4.3 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   5.4
 UPSTREAM NODE ELEVATION =    35.40
 DOWNSTREAM NODE ELEVATION =    29.94
 FLOWLENGTH(FEET) =   290.00   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      1.74
 TRAVEL TIME(MIN.) =     .89    TC(MIN.) =   9.73


****************************************************************************
 FLOW PROCESS FROM NODE     4.00 TO NODE     4.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   9.73
 RAINFALL INTENSITY(INCH/HR) =   1.46
 TOTAL STREAM AREA(ACRES) =    1.27
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.74

 ** CONFLUENCE DATA **
 STREAM      RUNOFF      Tc      INTENSITY      AREA
 NUMBER       (CFS)    (MIN.)   (INCH/HOUR)    (ACRE)
    1          1.25     8.07      1.631          .86
    2          1.74     9.73      1.458         1.27
```

```
 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
 STREAM     RUNOFF      Tc       INTENSITY
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
     1        2.80     8.07       1.631
     2        2.85     9.73       1.458

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      2.85   Tc(MIN.) =    9.73
 TOTAL AREA(ACRES) =      2.13


****************************************************************************
 FLOW PROCESS FROM NODE     4.00 TO NODE     4.00 IS CODE =   8
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.458
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 SUBAREA AREA(ACRES) =      .05   SUBAREA RUNOFF(CFS) =      .06
 TOTAL AREA(ACRES) =     2.18   TOTAL RUNOFF(CFS) =    2.91
 TC(MIN) =   9.73


****************************************************************************
 FLOW PROCESS FROM NODE     4.00 TO NODE     5.00 IS CODE =   4
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
============================================================================
 DEPTH OF FLOW IN  24.0 INCH PIPE IS   3.7 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   9.6
 UPSTREAM NODE ELEVATION =    29.94
 DOWNSTREAM NODE ELEVATION =    18.94
 FLOWLENGTH(FEET) =   158.20   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      2.91
 TRAVEL TIME(MIN.) =     .27    TC(MIN.) =  10.01


****************************************************************************
 FLOW PROCESS FROM NODE     5.00 TO NODE     6.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION =     18.94
 DOWNSTREAM NODE ELEVATION =     17.48
 CHANNEL LENGTH THRU SUBAREA(FEET) =   235.73
 CHANNEL SLOPE =    .0062
 CHANNEL BASE(FEET) =    2.46   "Z" FACTOR =   1.500
 MANNING'S FACTOR =  .015   MAXIMUM DEPTH(FEET) =     .72
 CHANNEL FLOW THRU SUBAREA(CFS) =      2.91
 FLOW VELOCITY(FEET/SEC) =   3.15   FLOW DEPTH(FEET) =     .32
 TRAVEL TIME(MIN.) =   1.25   TC(MIN.) =  11.26


****************************************************************************
 FLOW PROCESS FROM NODE     6.00 TO NODE     6.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =  11.26
 RAINFALL INTENSITY(INCH/HR) =   1.37
 TOTAL STREAM AREA(ACRES) =    2.18
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.91


****************************************************************************
```

```
 FLOW PROCESS FROM NODE    20.00 TO NODE    21.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 INITIAL SUBAREA FLOW-LENGTH =   300.00
 UPSTREAM ELEVATION =     39.71
 DOWNSTREAM ELEVATION =     34.46
 ELEVATION DIFFERENCE =      5.25
 URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =    6.468
   1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.797
 SUBAREA RUNOFF(CFS) =       .23
 TOTAL AREA(ACRES) =       .15   TOTAL RUNOFF(CFS) =       .23


****************************************************************************
 FLOW PROCESS FROM NODE    21.00 TO NODE    22.00 IS CODE =   6
----------------------------------------------------------------------------
 >>>>>COMPUTE STREETFLOW TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM ELEVATION =     34.46   DOWNSTREAM ELEVATION =     18.24
 STREET LENGTH(FEET) =   505.00   CURB HEIGHT(INCHES) = 6.
 STREET HALFWIDTH(FEET) = 22.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK =  20.00
 INTERIOR STREET CROSSFALL(DECIMAL) =    .030
 OUTSIDE STREET CROSSFALL(DECIMAL)  =    .030

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1

       **TRAVELTIME COMPUTED USING MEAN FLOW(CFS) =     .48
   STREETFLOW MODEL RESULTS:
       STREET FLOWDEPTH(FEET) =   .17
       HALFSTREET FLOODWIDTH(FEET) =    1.82
       AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.09
       PRODUCT OF DEPTH&VELOCITY =     .51
 STREETFLOW TRAVELTIME(MIN) =   2.72   TC(MIN) =   9.19

   1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.514
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 SUBAREA AREA(ACRES) =     .39   SUBAREA RUNOFF(CFS) =     .50
 SUMMED AREA(ACRES) =     .54   TOTAL RUNOFF(CFS) =       .73
 END OF SUBAREA STREETFLOW HYDRAULICS:
 DEPTH(FEET) =  .20   HALFSTREET FLOODWIDTH(FEET) =  3.10
 FLOW VELOCITY(FEET/SEC.) =  2.91   DEPTH*VELOCITY =    .59


****************************************************************************
 FLOW PROCESS FROM NODE    22.00 TO NODE     6.00 IS CODE =   4
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
============================================================================
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   2.7 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   4.4
 UPSTREAM NODE ELEVATION =    18.24
 DOWNSTREAM NODE ELEVATION =    17.48
 FLOWLENGTH(FEET) =    35.00   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =       .73
 TRAVEL TIME(MIN.) =    .13    TC(MIN.) =   9.32


****************************************************************************
 FLOW PROCESS FROM NODE     6.00 TO NODE     6.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   9.32
 RAINFALL INTENSITY(INCH/HR) =   1.50
```

```
 FLOW PROCESS FROM NODE    20.00 TO NODE    21.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 INITIAL SUBAREA FLOW-LENGTH =   300.00
 UPSTREAM ELEVATION =     39.71
 DOWNSTREAM ELEVATION =     34.46
 ELEVATION DIFFERENCE =      5.25
 URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =    6.468
   1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.797
 SUBAREA RUNOFF(CFS) =       .23
 TOTAL AREA(ACRES) =       .15   TOTAL RUNOFF(CFS) =       .23


****************************************************************************
 FLOW PROCESS FROM NODE    21.00 TO NODE    22.00 IS CODE =   6
----------------------------------------------------------------------------
 >>>>>COMPUTE STREETFLOW TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM ELEVATION =     34.46   DOWNSTREAM ELEVATION =     18.24
 STREET LENGTH(FEET) =   505.00   CURB HEIGHT(INCHES) = 6.
 STREET HALFWIDTH(FEET) = 22.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK =  20.00
 INTERIOR STREET CROSSFALL(DECIMAL) =    .030
 OUTSIDE STREET CROSSFALL(DECIMAL)  =    .030

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1

       **TRAVELTIME COMPUTED USING MEAN FLOW(CFS) =     .48
   STREETFLOW MODEL RESULTS:
       STREET FLOWDEPTH(FEET) =   .17
       HALFSTREET FLOODWIDTH(FEET) =    1.82
       AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.09
       PRODUCT OF DEPTH&VELOCITY =     .51
 STREETFLOW TRAVELTIME(MIN) =   2.72   TC(MIN) =   9.19

   1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.514
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 SUBAREA AREA(ACRES) =     .39   SUBAREA RUNOFF(CFS) =     .50
 SUMMED AREA(ACRES) =     .54   TOTAL RUNOFF(CFS) =       .73
 END OF SUBAREA STREETFLOW HYDRAULICS:
 DEPTH(FEET) =  .20   HALFSTREET FLOODWIDTH(FEET) =  3.10
 FLOW VELOCITY(FEET/SEC.) =  2.91   DEPTH*VELOCITY =    .59


****************************************************************************
 FLOW PROCESS FROM NODE    22.00 TO NODE     6.00 IS CODE =   4
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
============================================================================
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   2.7 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   4.4
 UPSTREAM NODE ELEVATION =    18.24
 DOWNSTREAM NODE ELEVATION =    17.48
 FLOWLENGTH(FEET) =    35.00   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =       .73
 TRAVEL TIME(MIN.) =    .13    TC(MIN.) =   9.32


****************************************************************************
 FLOW PROCESS FROM NODE     6.00 TO NODE     6.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   9.32
 RAINFALL INTENSITY(INCH/HR) =   1.50
```

```
 TOTAL STREAM AREA(ACRES) =      .54
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       .73

 ** CONFLUENCE DATA **
 STREAM      RUNOFF       Tc       INTENSITY       AREA
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)     (ACRE)
    1          2.91     11.26       1.371          2.18
    2           .73      9.32       1.500           .54

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
 STREAM      RUNOFF       Tc       INTENSITY
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)
    1          3.39      9.32       1.500
    2          3.58     11.26       1.371

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      3.58   Tc(MIN.) =   11.26
 TOTAL AREA(ACRES) =      2.72


****************************************************************************
 FLOW PROCESS FROM NODE      6.00 TO NODE      6.00 IS CODE =   8
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.371
 SOIL CLASSIFICATION IS "B"
 RURAL DEVELOPMENT RUNOFF COEFFICIENT = .3500
 SUBAREA AREA(ACRES) =     1.97   SUBAREA RUNOFF(CFS) =      .95
 TOTAL AREA(ACRES) =     4.69   TOTAL RUNOFF(CFS) =    4.53
 TC(MIN) =  11.26


****************************************************************************
 FLOW PROCESS FROM NODE      6.00 TO NODE      7.00 IS CODE =   4
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
============================================================================
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   5.2 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =  10.7
 UPSTREAM NODE ELEVATION =    17.48
 DOWNSTREAM NODE ELEVATION =    15.00
 FLOWLENGTH(FEET) =    41.49   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      4.53
 TRAVEL TIME(MIN.) =    .06    TC(MIN.) =  11.32


****************************************************************************
 FLOW PROCESS FROM NODE      7.00 TO NODE      7.00 IS CODE =   8
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.368
 SOIL CLASSIFICATION IS "B"
 SINGLE FAMILY DEVELOPMENT RUNOFF COEFFICIENT = .4500
 SUBAREA AREA(ACRES) =      .14   SUBAREA RUNOFF(CFS) =      .09
 TOTAL AREA(ACRES) =     4.83   TOTAL RUNOFF(CFS) =    4.61
 TC(MIN) =  11.32
============================================================================
 END OF STUDY SUMMARY:
 PEAK FLOW RATE(CFS) =      4.61   Tc(MIN.) =   11.32
 TOTAL AREA(ACRES) =      4.83
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************

          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                        1985,1981 HYDROLOGY MANUAL
        (c) Copyright 1982-96 Advanced Engineering Software (aes)
            Ver. 1.5A  Release Date: 01/01/96  License ID 1264

                          Analysis prepared by:

                    Robert Bein, William Frost & Associates
                              14725 Alton Parkway
                               Irvine, CA  92618
..........................................................................

 ************************** DESCRIPTION OF STUDY **************************
* JN34358 I-5/MANCHESTER AVE EXTENDED DETENTION BASIN                     *
* 25-YR STORM FREQUENCY                                                   *
* AMW                                                                     *
 **************************************************************************

  FILE NAME: I5MAN25.DAT
  TIME/DATE OF STUDY: 17:35   1/12/1999
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =   1.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =  .95
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS =  9
   1)   5.000;  3.850
   2)  10.000;  3.000
   3)  20.000;  2.140
   4)  30.000;  1.680
   5)  40.000;  1.420
   6)  50.000;  1.230
   7)  60.000;  1.090
   8) 120.000;   .700
   9) 180.000;   .540
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED


**************************************************************************
  FLOW PROCESS FROM NODE     1.00 TO NODE     2.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
  SOIL CLASSIFICATION IS "B"
  INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
  INITIAL SUBAREA FLOW-LENGTH =   300.00
  UPSTREAM ELEVATION =     57.50
  DOWNSTREAM ELEVATION =     48.82
  ELEVATION DIFFERENCE =      8.68
  URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =    5.470
  *CAUTION: SUBAREA SLOPE EXCEEDS COUNTY NOMOGRAPH
   DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.
  TIME OF CONCENTRATION ASSUMED AS 6-MINUTES
     1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.680
  SUBAREA RUNOFF(CFS) =       .88
  TOTAL AREA(ACRES) =       .28   TOTAL RUNOFF(CFS) =       .88


**************************************************************************
  FLOW PROCESS FROM NODE     2.00 TO NODE     3.00 IS CODE =   6
--------------------------------------------------------------------------
  >>>>>COMPUTE STREETFLOW TRAVELTIME THRU SUBAREA<<<<<
==========================================================================
  UPSTREAM ELEVATION =     48.82   DOWNSTREAM ELEVATION =     38.44
  STREET LENGTH(FEET) =   380.00   CURB HEIGHT(INCHES) = 6.
  STREET HALFWIDTH(FEET) = 58.00

I5MAN25.OUT                    5:36 PM  01/12/99                    1/6
```

```
 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK =  48.00
 INTERIOR STREET CROSSFALL(DECIMAL) =   .020
 OUTSIDE STREET CROSSFALL(DECIMAL)  =   .050

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1

      **TRAVELTIME COMPUTED USING MEAN FLOW(CFS) =    1.71
   STREETFLOW MODEL RESULTS:
      STREET FLOWDEPTH(FEET) =   .27
      HALFSTREET FLOODWIDTH(FEET) =    3.76
      AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.91
      PRODUCT OF DEPTH&VELOCITY =    1.05
 STREETFLOW TRAVELTIME(MIN) =   1.62   TC(MIN) =   7.62

   1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.405
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 SUBAREA AREA(ACRES) =     .58   SUBAREA RUNOFF(CFS) =    1.68
 SUMMED AREA(ACRES) =     .86   TOTAL RUNOFF(CFS) =     2.55
 END OF SUBAREA STREETFLOW HYDRAULICS:
 DEPTH(FEET) =  .31   HALFSTREET FLOODWIDTH(FEET) =  4.55
 FLOW VELOCITY(FEET/SEC.) =  4.24   DEPTH*VELOCITY =   1.31


****************************************************************************
 FLOW PROCESS FROM NODE     3.00 TO NODE     4.00 IS CODE =   4
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
============================================================================
 DEPTH OF FLOW IN  24.0 INCH PIPE IS   2.7 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =  13.0
 UPSTREAM NODE ELEVATION =    38.44
 DOWNSTREAM NODE ELEVATION =    29.94
 FLOWLENGTH(FEET) =    47.23   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      2.55
 TRAVEL TIME(MIN.) =    .06    TC(MIN.) =   7.68


****************************************************************************
 FLOW PROCESS FROM NODE     4.00 TO NODE     4.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =   7.68
 RAINFALL INTENSITY(INCH/HR) =   3.39
 TOTAL STREAM AREA(ACRES) =     .86
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.55


****************************************************************************
 FLOW PROCESS FROM NODE    10.00 TO NODE    11.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 INITIAL SUBAREA FLOW-LENGTH =   300.00
 UPSTREAM ELEVATION =     41.79
 DOWNSTREAM ELEVATION =     36.61
 ELEVATION DIFFERENCE =      5.18
 URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =    6.497
   1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.596
 SUBAREA RUNOFF(CFS) =       .92
 TOTAL AREA(ACRES) =       .30   TOTAL RUNOFF(CFS) =       .92


****************************************************************************
 FLOW PROCESS FROM NODE    11.00 TO NODE    12.00 IS CODE =   6
----------------------------------------------------------------------------
 >>>>>COMPUTE STREETFLOW TRAVELTIME THRU SUBAREA<<<<<
============================================================================
```

```
 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
 STREAM     RUNOFF      Tc       INTENSITY
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
    1         5.86     7.68       3.394
    2         5.94     9.29       3.121

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      5.94   Tc(MIN.) =    9.29
 TOTAL AREA(ACRES) =      2.13


****************************************************************************
 FLOW PROCESS FROM NODE     4.00 TO NODE     4.00 IS CODE =   8
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.121
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 SUBAREA AREA(ACRES) =     .05   SUBAREA RUNOFF(CFS) =     .13
 TOTAL AREA(ACRES) =     2.18   TOTAL RUNOFF(CFS) =    6.07
 TC(MIN) =   9.29


****************************************************************************
 FLOW PROCESS FROM NODE     4.00 TO NODE     5.00 IS CODE =   4
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
============================================================================
 DEPTH OF FLOW IN  24.0 INCH PIPE IS   5.2 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =  12.0
 UPSTREAM NODE ELEVATION =    29.94
 DOWNSTREAM NODE ELEVATION =    18.94
 FLOWLENGTH(FEET) =   158.20   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      6.07
 TRAVEL TIME(MIN.) =    .22    TC(MIN.) =   9.51


****************************************************************************
 FLOW PROCESS FROM NODE     5.00 TO NODE     6.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION =     18.94
 DOWNSTREAM NODE ELEVATION =     17.48
 CHANNEL LENGTH THRU SUBAREA(FEET) =   235.73
 CHANNEL SLOPE =    .0062
 CHANNEL BASE(FEET) =    2.46   "Z" FACTOR =   1.500
 MANNING'S FACTOR =  .015   MAXIMUM DEPTH(FEET) =    .72
 CHANNEL FLOW THRU SUBAREA(CFS) =      6.07
 FLOW VELOCITY(FEET/SEC) =   4.00   FLOW DEPTH(FEET) =    .48
 TRAVEL TIME(MIN.) =    .98   TC(MIN.) =  10.49


****************************************************************************
 FLOW PROCESS FROM NODE     6.00 TO NODE     6.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =  10.49
 RAINFALL INTENSITY(INCH/HR) =   2.96
 TOTAL STREAM AREA(ACRES) =    2.18
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      6.07


****************************************************************************
```

```
 FLOW PROCESS FROM NODE    20.00 TO NODE    21.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 INITIAL SUBAREA FLOW-LENGTH =   300.00
 UPSTREAM ELEVATION =     39.71
 DOWNSTREAM ELEVATION =     34.46
 ELEVATION DIFFERENCE =      5.25
 URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =    6.468
   1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.600
 SUBAREA RUNOFF(CFS) =       .46
 TOTAL AREA(ACRES) =       .15   TOTAL RUNOFF(CFS) =       .46


****************************************************************************
 FLOW PROCESS FROM NODE    21.00 TO NODE    22.00 IS CODE =   6
----------------------------------------------------------------------------
 >>>>>COMPUTE STREETFLOW TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM ELEVATION =     34.46   DOWNSTREAM ELEVATION =     18.24
 STREET LENGTH(FEET) =   505.00   CURB HEIGHT(INCHES) = 6.
 STREET HALFWIDTH(FEET) = 22.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK =  20.00
 INTERIOR STREET CROSSFALL(DECIMAL) =   .030
 OUTSIDE STREET CROSSFALL(DECIMAL)  =   .030

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1

       **TRAVELTIME COMPUTED USING MEAN FLOW(CFS) =     .98
   STREETFLOW MODEL RESULTS:
       STREET FLOWDEPTH(FEET) =   .22
       HALFSTREET FLOODWIDTH(FEET) =    3.74
       AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.11
       PRODUCT OF DEPTH&VELOCITY =     .69
 STREETFLOW TRAVELTIME(MIN) =   2.71   TC(MIN) =   9.18

   1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.140
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 SUBAREA AREA(ACRES) =     .39   SUBAREA RUNOFF(CFS) =    1.04
 SUMMED AREA(ACRES) =     .54   TOTAL RUNOFF(CFS) =     1.50
 END OF SUBAREA STREETFLOW HYDRAULICS:
 DEPTH(FEET) =  .24   HALFSTREET FLOODWIDTH(FEET) =  4.38
 FLOW VELOCITY(FEET/SEC.) =  3.80   DEPTH*VELOCITY =    .92

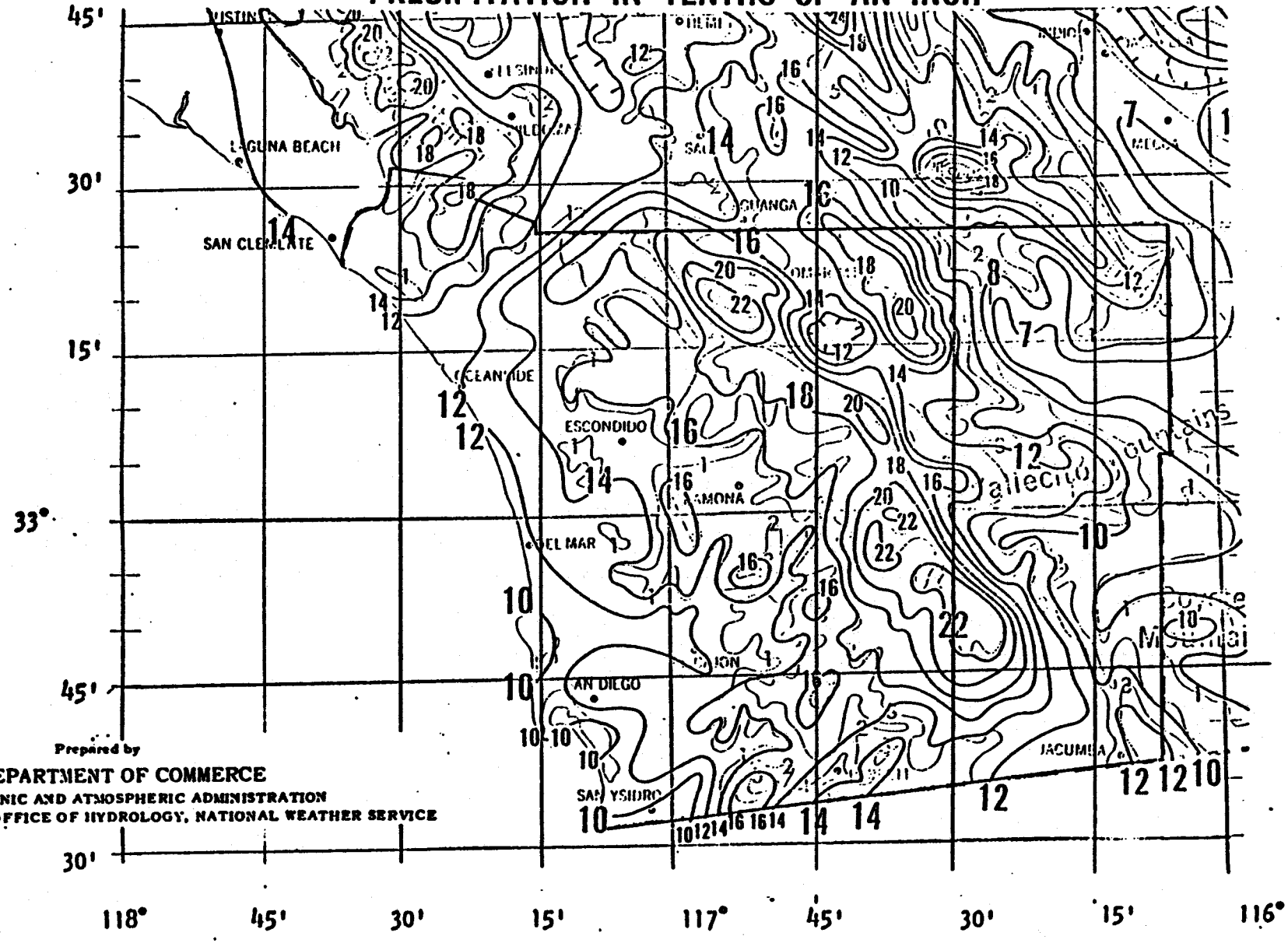

****************************************************************************
 FLOW PROCESS FROM NODE    22.00 TO NODE     6.00 IS CODE =   4
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
============================================================================
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   3.8 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   5.4
 UPSTREAM NODE ELEVATION =    18.24
 DOWNSTREAM NODE ELEVATION =    17.48
 FLOWLENGTH(FEET) =    35.00   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      1.50
 TRAVEL TIME(MIN.) =    .11    TC(MIN.) =   9.28


****************************************************************************
 FLOW PROCESS FROM NODE     6.00 TO NODE     6.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   9.28
 RAINFALL INTENSITY(INCH/HR) =   3.12
```

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

2-YEAR 6-HOUR PRECIPITATION

—10— ISOPLUVIALS OF 2-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH



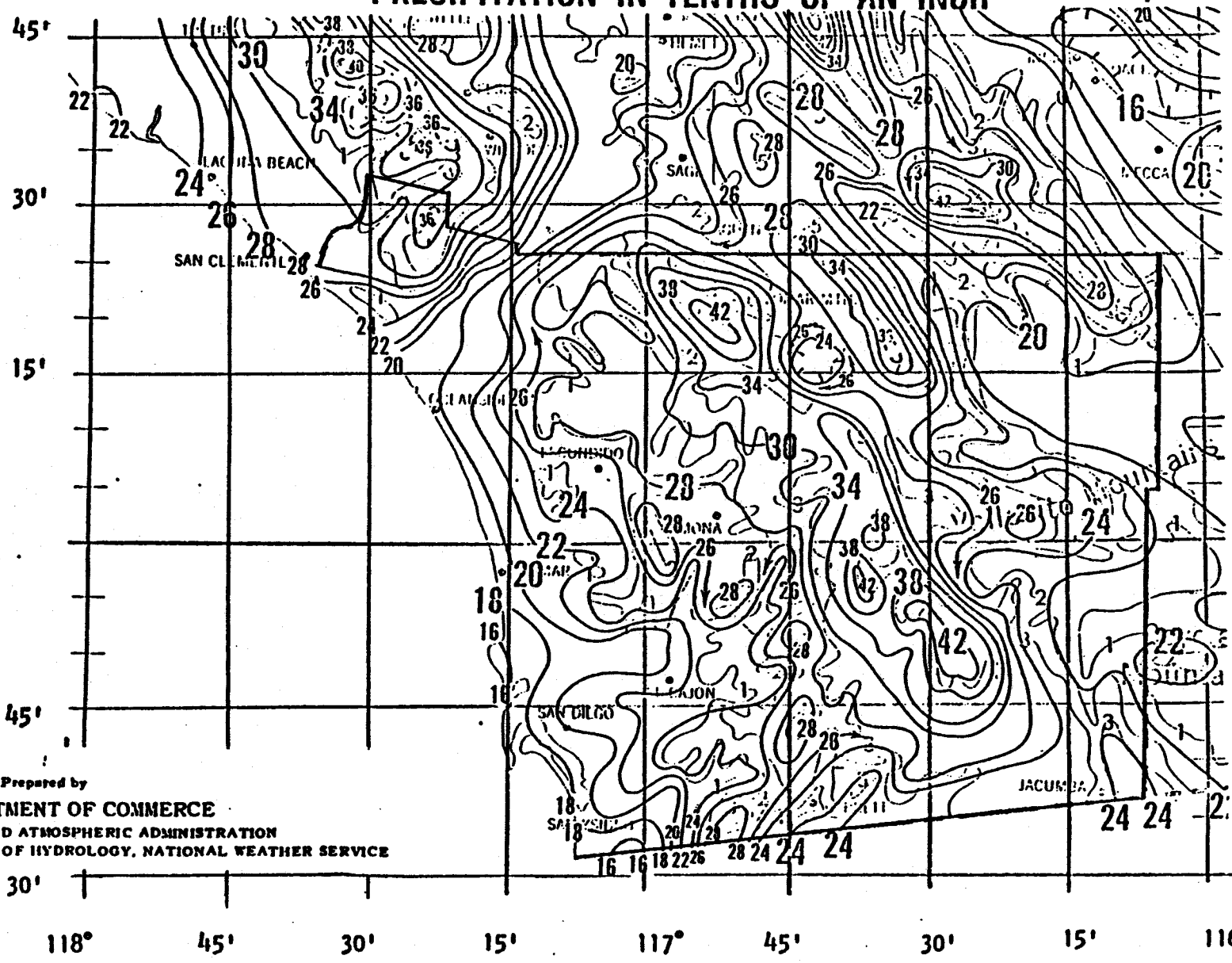
Prepared by

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

25-YEAR 6-HOUR PRECIPITATION

(16) ISOPLUVIALS OF 25-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH



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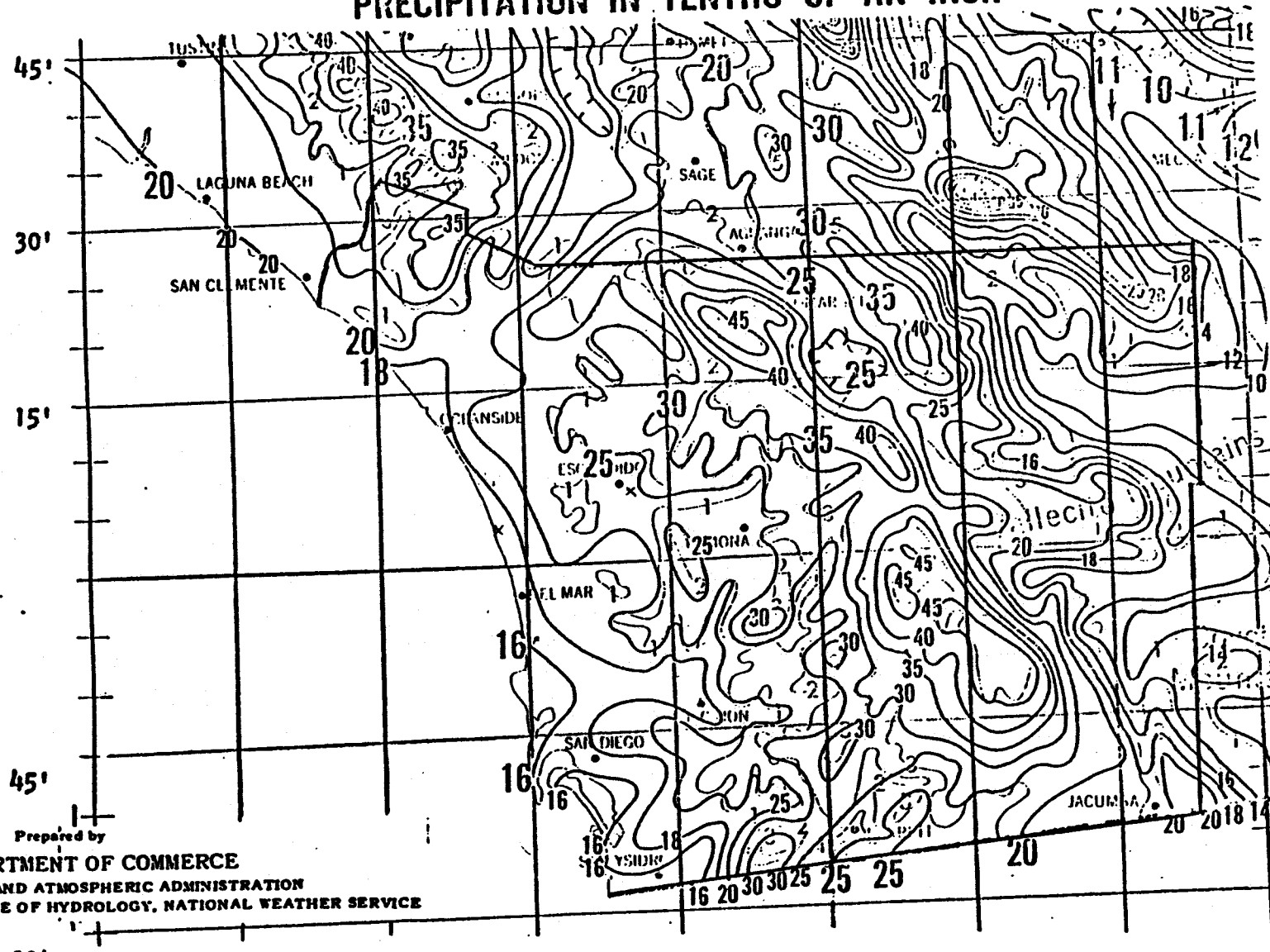
2-YEAR 24-HOUR PRECIPITATION

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

—10— ISOPLUVIALS OF 2-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH



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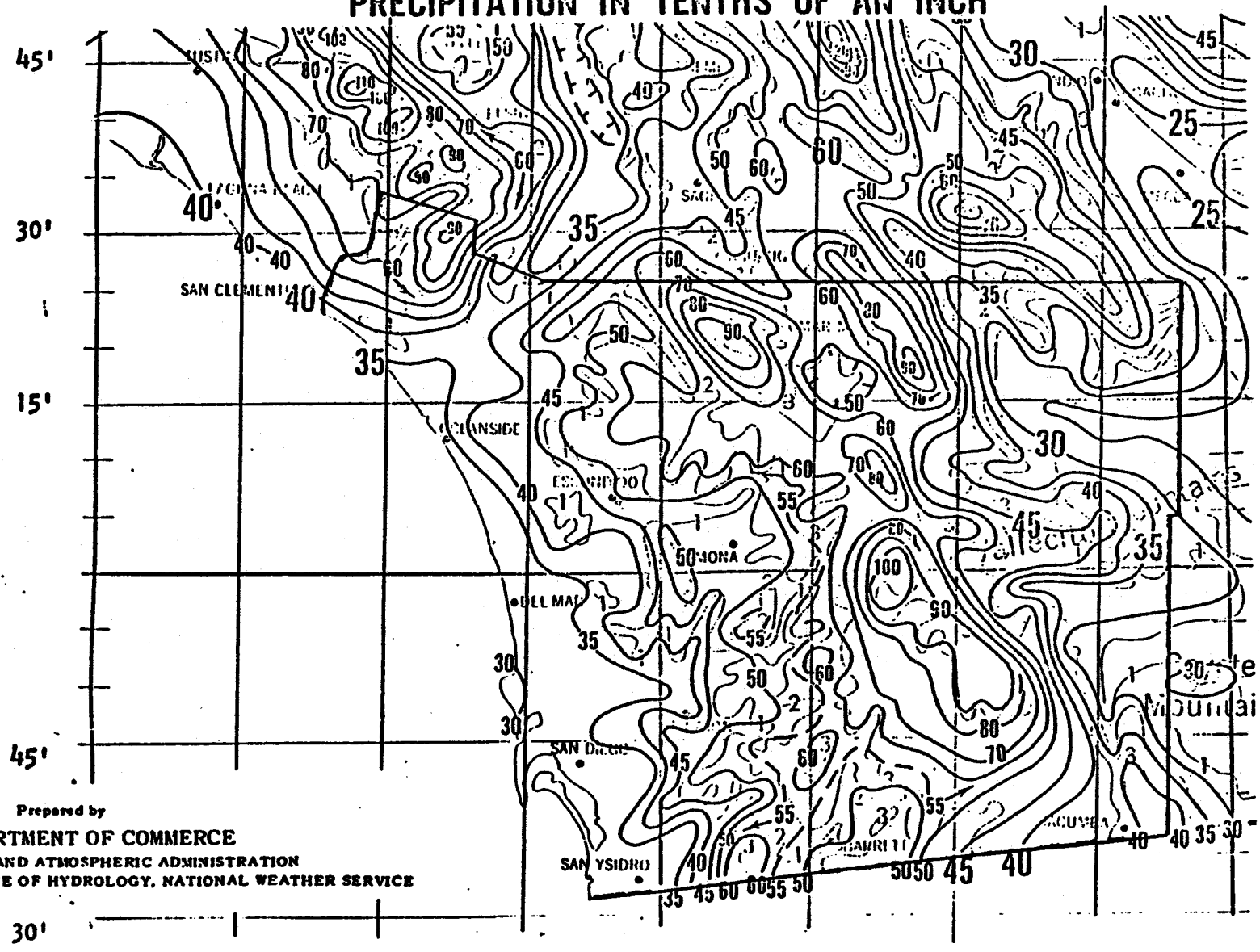
25-YEAR 24-HOUR PRECIPITATION

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

~20~ ISOPLUVIALS OF 25-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH



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SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

I-5/MANCHESTER AVE

6 MOS - 24 HOUR STORM

SD DEPT PUBLIC WORKS FLOOD CONTROL - HYDROLOGY MANUAL

1YR, 2YR + 5YR STORM EXTRAPOLATION

FROM THE RAINFALL INTENSITY - DURATION - FREQUENCY CURVES

STORM FREQUENCY	Δ	DURATION (HRS)	INTENSITY $\frac{IN}{HR}$	RATIO
6MOS		1	Y	
	0.5			X
1YR		1	0.48	
	1.0			0.7869
2YR		1	0.61	
	3			0.7821
5YR		1	0.78	

6-MOS / 1YR RATIO:

Δ	RATIO
0.5YR	X
1YR	0.7869
3YR	0.7821

$X = (0.7821) + \frac{2}{0.5}(0.0048)$

$X = 0.8013$

6-MOS/1YR INTENSITY:

$Y = 0.48(x)$

$= 0.48(0.8013)$

$= 0.3846 \frac{IN}{HR}$

STORM DURATION PTS FOR THE RAIN MASS CURVE

$\frac{6\text{MOS}}{2\text{YR}}$ INTENSITY RATIO $= \frac{0.3846 \frac{IN}{HR}}{0.61 \frac{IN}{HR}} = 0.6305$

MANCHESTER (ISOPLUVIALS 2YR-24HR = 1.6 IN, 2YR-6-HR = 1.0 IN)

6-MOS 24-HR = INTENSITY RATIO (INCHES OF RAIN)

$= 0.6305(1.6\text{ IN}) = 1.0088\text{ IN}$

6-MOS 6-HR = $0.6305(1.0\text{ IN}) = 0.6305\text{ IN}$

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JOB CALTRANS BMP - 4358
SHEET NO. _____ OF _____
CALCULATED BY AMW DATE _____
CHECKED BY _____ DATE _____
SCALE _____

NB I-5 / MANCHESTER AVE EDB

1-YR STORM EXTRAPOLATION

2YR - 24HR ISOPLUVIAL 1.6 $\frac{IN}{HR}$
2 YR - 6 HR ISOPLUVIAL 1.0 $\frac{IN}{HR}$

2-YR - 60MIN INTENSITY = 0.61 $\frac{IN}{HR}$ IDF CURVE
1-YR - 60MIN INTENSITY = 0.48 $\frac{IN}{HR}$

FACTOR = $\frac{1YR}{2YR} = \frac{0.48}{0.61} = 0.787$

$\Rightarrow$ 1-YR - 24 HR : $1.6 \frac{IN}{HR} (0.787) = 1.26$ IN

1 - YR - 6 HR : $1.0 \frac{IN}{HR} (0.787) = 0.787$ IN

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949.472.3505 • FAX 949.472.8373

JOB 34358 - I-5 / MANCHESTER AVE
SHEET NO. _____ OF _____
CALCULATED BY AML DATE 12/98
CHECKED BY _____ DATE _____
SCALE _____

LOSS RATE CALCULATION

SOIL GROUP A

$F_p = 0.30$

$A_p = \frac{2.11 \text{ AC}}{4.83 \text{ AC}} = 0.4369$

PAVEMENT AREA = 2.72 AC
PERVIOUS AREA = 2.11 AC
TOTAL AREA 4.83 AC

$F_M = A_p F_p$
$= 0.4369 (0.30)$
$= 0.1311$

$I_A = 0.25$

$S = \frac{1000}{CN} - 10$

CN = 90 ROADWAY
86 SLOPES
88.25 WEIGHTED

$S = \frac{1000}{88.25} - 10$
$= 1.33$

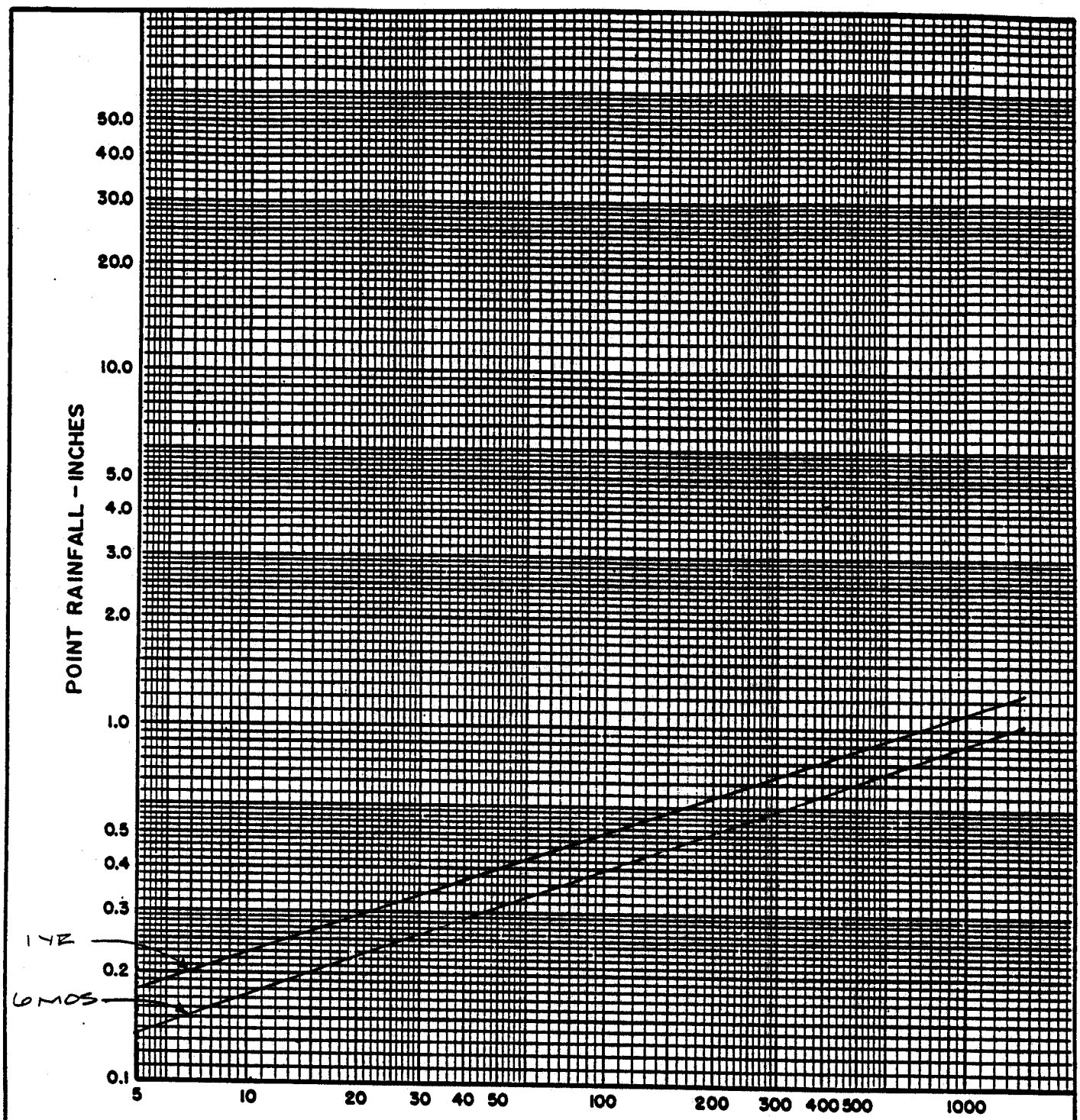
$I_A = 0.2 (1.33)$
$= 0.27$

$Y_J = \frac{(P_{24} - I_A)^2}{(P_{24} - I_A + S) P_{24}} = \frac{(1.26 - 0.27)^2}{(1.26 - 0.27 + 1.33) 1.26} = 0.3353$: 1-YR-24HR

$P_{24} = 1.01$ IN $\Rightarrow Y_J = 0.2619$: 6-MOS-24HR

$\bar{Y} = 1 - Y$
$= 1 - 0.3353$

$\bar{Y}_{1YR} = 0.6647$ || $\bar{Y}_{6MOS} = 0.7381$



PROJECT LOCATION NB I-5 / MANCHESTER AVE

NOTES

AREA - AVERAGED
MASS RAINFALL
PLOTTING SHEET

Figure B-7

SMALL AREA UNIT HYDROGRAPH MODEL

Analysis prepared by:

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RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
TOTAL CATCHMENT AREA(ACRES) = 4.83
SOIL-LOSS RATE, Fm,(INCH/HR) = 0.131
LOW LOSS FRACTION = 0.738
TIME OF CONCENTRATION(MIN.) = 11.73
RATIONAL METHOD PEAK FLOW RATE (DEFINED BY USER)
IS USED FOR SMALL AREA PEAK Q
USER SPECIFIED RAINFALL VALUES ARE USED
RETURN FREQUENCY(YEARS) = 2
5-MINUTE POINT RAINFALL VALUE(INCHES) = 0.15
30-MINUTE POINT RAINFALL VALUE(INCHES) = 0.27
1-HOUR POINT RAINFALL VALUE(INCHES) = 0.34
3-HOUR POINT RAINFALL VALUE(INCHES) = 0.50
6-HOUR POINT RAINFALL VALUE(INCHES) = 0.63
24-HOUR POINT RAINFALL VALUE(INCHES) = 1.01

TOTAL CATCHMENT RUNOFF VOLUME(ACRE-FEET) = 0.13
TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) = 0.28

TIME (HOURS)	VOLUME (AF)	Q (CFS)	0.	2.5	5.0	7.5	10.0
0.165	0.0000	0.00	Q	.	.	.	.
0.360	0.0000	0.00	Q	.	.	.	.
0.556	0.0000	0.00	Q	.	.	.	.
0.751	0.0000	0.00	Q	.	.	.	.
0.947	0.0000	0.00	Q	.	.	.	.
1.142	0.0000	0.00	Q	.	.	.	.
1.338	0.0000	0.00	Q	.	.	.	.
1.533	0.0000	0.00	Q	.	.	.	.
1.729	0.0000	0.00	Q	.	.	.	.
1.924	0.0000	0.00	Q	.	.	.	.
2.120	0.0000	0.00	Q	.	.	.	.
2.315	0.0000	0.00	Q	.	.	.	.
2.511	0.0000	0.00	Q	.	.	.	.
2.706	0.0000	0.00	Q	.	.	.	.
2.902	0.0000	0.00	Q	.	.	.	.
3.097	0.0000	0.00	Q	.	.	.	.
3.293	0.0000	0.00	Q	.	.	.	.
3.488	0.0000	0.00	Q	.	.	.	.
3.684	0.0000	0.00	Q	.	.	.	.
3.879	0.0000	0.00	Q	.	.	.	.
4.075	0.0000	0.00	Q	.	.	.	.
4.270	0.0000	0.00	Q	.	.	.	.
4.466	0.0000	0.00	Q	.	.	.	.
4.661	0.0000	0.00	Q	.	.	.	.
4.857	0.0000	0.00	Q	.	.	.	.
5.052	0.0000	0.00	Q	.	.	.	.
5.248	0.0000	0.00	Q	.	.	.	.
5.443	0.0000	0.00	Q	.	.	.	.
5.639	0.0000	0.00	Q	.	.	.	.
5.834	0.0000	0.00	Q	.	.	.	.
6.030	0.0000	0.00	Q	.	.	.	.
6.225	0.0002	0.02	Q	.	.	.	.
6.421	0.0005	0.02	Q	.	.	.	.
6.616	0.0009	0.02	Q	.	.	.	.

6.812	0.0013	0.02	Q	.	.	.	.	.	.	.	.	.
7.007	0.0017	0.02	Q	.	.	.	.	.	.	.	.	.
7.203	0.0020	0.02	Q	.	.	.	.	.	.	.	.	.
7.398	0.0024	0.02	Q	.	.	.	.	.	.	.	.	.
7.594	0.0028	0.02	Q	.	.	.	.	.	.	.	.	.
7.789	0.0032	0.02	Q	.	.	.	.	.	.	.	.	.
7.984	0.0036	0.03	QQ	.	.	.	.	.	.	.	.	.
8.180	0.0041	0.03	QQ	.	.	.	.	.	.	.	.	.
8.376	0.0045	0.03	QQ	.	.	.	.	.	.	.	.	.
8.571	0.0049	0.03	QQ	.	.	.	.	.	.	.	.	.
8.766	0.0053	0.03	QQ	.	.	.	.	.	.	.	.	.
8.962	0.0058	0.03	QQ	.	.	.	.	.	.	.	.	.
9.158	0.0062	0.03	QQ	.	.	.	.	.	.	.	.	.
9.353	0.0067	0.03	QQ	.	.	.	.	.	.	.	.	.
9.549	0.0072	0.03	QQQ	.	.	.	.	.	.	.	.	.
9.744	0.0076	0.03	QQQ	.	.	.	.	.	.	.	.	.
9.939	0.0081	0.03	QQQ	.	.	.	.	.	.	.	.	.
10.135	0.0086	0.03	QQQ	.	.	.	.	.	.	.	.	.
10.331	0.0091	0.03	QQQ	.	.	.	.	.	.	.	.	.
10.526	0.0096	0.03	QQQ	.	.	.	.	.	.	.	.	.
10.722	0.0102	0.03	QQQQ	.	.	.	.	.	.	.	.	.
10.917	0.0107	0.03	QQQQ	.	.	.	.	.	.	.	.	.
11.113	0.0113	0.04	QQQQ	.	.	.	.	.	.	.	.	.
11.308	0.0118	0.04	QQQQ	.	.	.	.	.	.	.	.	.
11.503	0.0124	0.04	QQQQ	.	.	.	.	.	.	.	.	.
11.699	0.0130	0.04	QQQQ	.	.	.	.	.	.	.	.	.
11.894	0.0137	0.04	QQQQQ	.	.	.	.	.	.	.	.	.
12.090	0.0143	0.04	QQQQQ	.	.	.	.	.	.	.	.	.
12.286	0.0149	0.04	QQQQQ	.	.	.	.	.	.	.	.	.
12.481	0.0156	0.04	QQQQQ	.	.	.	.	.	.	.	.	.
12.677	0.0163	0.04	QQQQQ	.	.	.	.	.	.	.	.	.
12.872	0.0170	0.05	QQQQQQ	.	.	.	.	.	.	.	.	.
13.068	0.0178	0.05	QQQQQQ	.	.	.	.	.	.	.	.	.
13.263	0.0186	0.05	QQQQQQ	.	.	.	.	.	.	.	.	.
13.458	0.0194	0.05	QQQQQQ	.	.	.	.	.	.	.	.	.
13.654	0.0202	0.05	QQQQQQQ	.	.	.	.	.	.	.	.	.
13.850	0.0211	0.06	QQQQQQQ	.	.	.	.	.	.	.	.	.
14.045	0.0221	0.06	QQQQQQQ	.	.	.	.	.	.	.	.	.
14.240	0.0231	0.07	QQQQQQQQ	.	.	.	.	.	.	.	.	.
14.436	0.0243	0.07	QQQQQQQQ	.	.	.	.	.	.	.	.	.
14.632	0.0255	0.08	QQQQQQQQ	.	.	.	.	.	.	.	.	.
14.827	0.0269	0.09	QQQQQQQQQ	.	.	.	.	.	.	.	.	.
15.023	0.0283	0.10	QQQQQQQQQ	.	.	.	.	.	.	.	.	.
15.218	0.0300	0.11	QQQQQQQQQQ.		.	.	.	.	.	.	.	.
15.413	0.0319	0.13	QQQQQQQQQQ.		.	.	.	.	.	.	.	.
15.609	0.0341	0.14	QQQQQQQQQQ.		.	.	.	.	.	.	.	.
15.805	0.0370	0.22	QQQQQQQQQQ.		.	.	.	.	.	.	.	.
16.000	0.0433	0.56	.QQQQQQQQ.Q		.	.	.	.	.	.	.	.
16.195	0.0772	3.64	.QQQQQQQQ.Q	QQ	.	.	.	.	.	.	.	.
16.391	0.1079	0.17	QQQQQQQQQ.Q	QQ	.	Q	.	.	.	.	.	.
16.587	0.1102	0.12	QQQQQQQQQ.Q	QQ	.	Q	.	Q	.	.	.	.
16.782	0.1119	0.09	QQQQQQQQQ.Q	QQ	.	Q	.	QQ	.	.	.	.
16.978	0.1132	0.08	QQQQQQQQQ.Q	QQ	.	Q	.	QQ	.	.	.	.
17.173	0.1144	0.06	QQQQQQQQQ.Q	QQ	.	Q	.	QQQ	.	.	.	.
17.368	0.1153	0.06	QQQQQQQQQ.Q	QQ	.	Q	.	QQQ	.	.	.	.
17.564	0.1162	0.05	QQQQQQQQQ.Q	QQ	.	Q	.	QQQ	.	.	.	.
17.759	0.1170	0.05	QQQQQQQQQ.Q	QQ	.	Q	.	QQQ	.	.	.	.
17.955	0.1177	0.04	QQQQQQQQQ.Q	QQ	.	Q	.	QQQQ	.	.	.	.
18.151	0.1184	0.04	QQQQQQQQQ.Q	QQ	.	Q	.	QQQQ	.	.	.	.
18.346	0.1190	0.04	QQQQQQQQQ.Q	QQ	.	Q	.	QQQQ	.	.	.	.
18.542	0.1196	0.04	QQQQQQQQQ.Q	QQ	.	Q	.	QQQQ	.	.	.	.
18.737	0.1202	0.03	QQQQQQQQQ.Q	QQ	.	Q	.	QQQQQ	.	.	.	.
18.932	0.1207	0.03	QQQQQQQQQ.Q	QQ	.	Q	.	QQQQQ	.	.	.	.
19.128	0.1213	0.03	QQQQQQQQQ.Q	QQ	.	Q	.	QQQQQ	.	.	.	.
19.323	0.1217	0.03	QQQQQQQQQ.Q	QQ	.	Q	.	QQQQQ	.	.	.	.
19.519	0.1222	0.03	QQQQQQQQQ.Q	QQ	.	Q	.	QQQQQ	.	.	.	.
19.715	0.1227	0.03	QQQQQQQQQ.Q	QQ	.	Q	.	QQQQQ	.	.	.	.
19.910	0.1231	0.03	QQQQQQQQQ.Q	QQ	.	Q	.	QQQQQQ.		.	.	.
20.105	0.1236	0.03	QQQQQQQQQ.Q	QQ	.	Q	.	QQQQQQ.		.	.	.
20.301	0.1240	0.03	QQQQQQQQQ.Q	QQ	.	Q	.	QQQQQQ.		.	.	.
20.497	0.1244	0.02	QQQQQQQQQ.Q	QQ	.	Q	.	QQQQQQ.		.	.	.
20.692	0.1248	0.02	QQQQQQQQQ.Q	QQ	.	Q	.	QQQQQQ.		.	.	.
20.888	0.1251	0.02	QQQQQQQQQ.Q	QQ	.	Q	.	QQQQQQ.		.	.	.
21.083	0.1255	0.02	QQQQQQQQQ.Q	QQ	.	Q	.	QQQQQQ.		.	.	.
21.278	0.1257	0.00	QQQQQQQQQ.Q	QQ	.	Q	.	QQQQQQ.		.	.	.

21.474	0.1257	0.00	QQQQQQQQQQ.Q QQ	.	Q	.	QQQQQQ.
21.670	0.1257	0.00	QQQQQQQQQQ.Q QQ	.	Q	.	QQQQQQ.
21.865	0.1257	0.00	QQQQQQQQQQ.Q QQ	.	Q	.	QQQQQQ.
22.060	0.1257	0.00	QQQQQQQQQQ.Q QQ	.	Q	.	QQQQQQ.
22.256	0.1257	0.00	QQQQQQQQQQ.Q QQ	.	Q	.	QQQQQQ.
22.451	0.1257	0.00	QQQQQQQQQQ.Q QQ	.	Q	.	QQQQQQ.
22.647	0.1257	0.00	QQQQQQQQQQ.Q QQ	.	Q	.	QQQQQQ.
22.842	0.1257	0.00	QQQQQQQQQQ.Q QQ	.	Q	.	QQQQQQ.
23.038	0.1257	0.00	QQQQQQQQQQ.Q QQ	.	Q	.	QQQQQQ.
23.233	0.1257	0.00	QQQQQQQQQQ.Q QQ	.	Q	.	QQQQQQ.
23.429	0.1257	0.00	QQQQQQQQQQ.Q QQ	.	Q	.	QQQQQQ.
23.625	0.1257	0.00	QQQQQQQQQQ.Q QQ	.	Q	.	QQQQQQ.
23.820	0.1257	0.00	QQQQQQQQQQ.Q QQ	.	Q	.	QQQQQQ.
24.015	0.1257	0.00	QQQQQQQQQQ.Q QQ	.	Q	.	QQQQQQ.
24.211	0.1257	0.00	QQQQQQQQQQ.Q QQ	.	Q	.	QQQQQQ.

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SMALL AREA UNIT HYDROGRAPH MODEL

Ver. 6.1 Release Date: 01/01/98 License ID 1264

Analysis prepared by:

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RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
TOTAL CATCHMENT AREA(ACRES) = 4.83
SOIL-LOSS RATE, Fm,(INCH/HR) = 0.131
LOW LOSS FRACTION = 0.665
TIME OF CONCENTRATION(MIN.) = 11.32
RATIONAL METHOD PEAK FLOW RATE (DEFINED BY USER)
IS USED FOR SMALL AREA PEAK Q
USER SPECIFIED RAINFALL VALUES ARE USED
RETURN FREQUENCY(YEARS) = 2
5-MINUTE POINT RAINFALL VALUE(INCHES) = 0.18
30-MINUTE POINT RAINFALL VALUE(INCHES) = 0.34
1-HOUR POINT RAINFALL VALUE(INCHES) = 0.42
3-HOUR POINT RAINFALL VALUE(INCHES) = 0.65
6-HOUR POINT RAINFALL VALUE(INCHES) = 0.79
24-HOUR POINT RAINFALL VALUE(INCHES) = 1.26

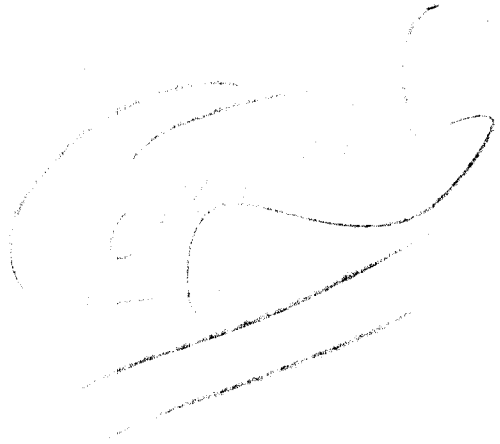
TOTAL CATCHMENT RUNOFF VOLUME(ACRE-FEET) = 0.20
TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) = 0.30

****

TIME (HOURS)	VOLUME (AF)	Q (CFS)	0.	2.5	5.0	7.5	10.0
0.152	0.0000	0.00	Q	.	.	.	.
0.341	0.0002	0.03	Q	.	.	.	.
0.529	0.0006	0.03	Q	.	.	.	.
0.718	0.0010	0.03	Q	.	.	.	.
0.907	0.0014	0.03	Q	.	.	.	.
1.095	0.0018	0.03	Q	.	.	.	.
1.284	0.0023	0.03	Q	.	.	.	.
1.473	0.0027	0.03	Q	.	.	.	.
1.661	0.0031	0.03	Q	.	.	.	.
1.850	0.0036	0.03	Q	.	.	.	.
2.039	0.0040	0.03	Q	.	.	.	.
2.227	0.0044	0.03	Q	.	.	.	.
2.416	0.0049	0.03	Q	.	.	.	.
2.605	0.0053	0.03	Q	.	.	.	.
2.793	0.0058	0.03	Q	.	.	.	.
2.982	0.0062	0.03	Q	.	.	.	.
3.171	0.0067	0.03	Q	.	.	.	.
3.359	0.0071	0.03	Q	.	.	.	.
3.548	0.0076	0.03	Q	.	.	.	.
3.737	0.0081	0.03	Q	.	.	.	.
3.925	0.0086	0.03	Q	.	.	.	.
4.114	0.0090	0.03	Q	.	.	.	.
4.303	0.0095	0.03	Q	.	.	.	.
4.491	0.0100	0.03	Q	.	.	.	.
4.680	0.0105	0.03	Q	.	.	.	.
4.869	0.0110	0.03	Q	.	.	.	.
5.057	0.0115	0.03	Q	.	.	.	.
5.246	0.0120	0.03	Q	.	.	.	.
5.435	0.0126	0.03	Q	.	.	.	.
5.623	0.0131	0.03	Q	.	.	.	.
5.812	0.0136	0.03	Q	.	.	.	.
6.001	0.0142	0.03	Q	.	.	.	.
6.189	0.0147	0.04	Q	.	.	.	.
6.378	0.0153	0.04	Q	.	.	.	.

6.567	0.0158	0.04	Q	.	.	.	.
6.755	0.0164	0.04	Q	.	.	.	.
6.944	0.0170	0.04	Q	.	.	.	.
7.133	0.0176	0.04	Q	.	.	.	.
7.321	0.0181	0.04	Q	.	.	.	.
7.510	0.0187	0.04	Q	.	.	.	.
7.699	0.0194	0.04	Q	.	.	.	.
7.887	0.0200	0.04	Q	.	.	.	.
8.076	0.0206	0.04	Q	.	.	.	.
8.265	0.0212	0.04	Q	.	.	.	.
8.453	0.0219	0.04	Q	.	.	.	.
8.642	0.0225	0.04	Q	.	.	.	.
8.831	0.0232	0.04	Q	.	.	.	.
9.019	0.0239	0.04	Q	.	.	.	.
9.208	0.0246	0.04	Q	.	.	.	.
9.397	0.0253	0.05	Q	.	.	.	.
9.585	0.0260	0.05	Q	.	.	.	.
9.774	0.0267	0.05	Q	.	.	.	.
9.963	0.0275	0.05	Q	.	.	.	.
10.151	0.0283	0.05	Q	.	.	.	.
10.340	0.0290	0.05	Q	.	.	.	.
10.529	0.0298	0.05	Q	.	.	.	.
10.717	0.0306	0.05	Q	.	.	.	.
10.906	0.0315	0.05	Q	.	.	.	.
11.095	0.0323	0.06	Q	.	.	.	.
11.283	0.0332	0.06	Q	.	.	.	.
11.472	0.0341	0.06	Q	.	.	.	.
11.661	0.0350	0.06	Q	.	.	.	.
11.849	0.0360	0.06	Q	.	.	.	.
12.038	0.0369	0.06	Q	.	.	.	.
12.227	0.0379	0.06	Q	.	.	.	.
12.415	0.0387	0.06	Q	.	.	.	.
12.604	0.0396	0.06	Q	.	.	.	.
12.793	0.0406	0.06	Q	.	.	.	.
12.981	0.0416	0.06	Q	.	.	.	.
13.170	0.0426	0.07	Q	.	.	.	.
13.359	0.0436	0.07	Q	.	.	.	.
13.547	0.0448	0.07	Q	.	.	.	.
13.736	0.0459	0.08	Q	.	.	.	.
13.925	0.0472	0.08	Q	.	.	.	.
14.113	0.0485	0.09	Q	.	.	.	.
14.302	0.0502	0.13	Q	.	.	.	.
14.491	0.0523	0.14	Q	.	.	.	.
14.679	0.0546	0.15	Q	.	.	.	.
14.868	0.0570	0.16	Q	.	.	.	.
15.057	0.0597	0.18	Q	.	.	.	.
15.245	0.0627	0.20	Q	.	.	.	.
15.434	0.0660	0.22	Q	.	.	.	.
15.623	0.0693	0.21	Q	.	.	.	.
15.811	0.0747	0.48	.Q	.	.	.	.
16.000	0.0860	0.98	. Q	.	.	.	.
16.189	0.1295	4.61	.	.	Q .	.	.
16.377	0.1674	0.25	.Q	.	.	.	.
16.566	0.1711	0.22	Q	.	.	.	.
16.755	0.1741	0.17	Q	.	.	.	.
16.943	0.1765	0.15	Q	.	.	.	.
17.132	0.1786	0.12	Q	.	.	.	.
17.321	0.1802	0.08	Q	.	.	.	.
17.509	0.1814	0.07	Q	.	.	.	.
17.698	0.1825	0.07	Q	.	.	.	.
17.887	0.1835	0.06	Q	.	.	.	.
18.075	0.1844	0.06	Q	.	.	.	.
18.264	0.1853	0.06	Q	.	.	.	.
18.453	0.1862	0.06	Q	.	.	.	.
18.641	0.1871	0.06	Q	.	.	.	.
18.830	0.1880	0.05	Q	.	.	.	.
19.019	0.1888	0.05	Q	.	.	.	.
19.207	0.1896	0.05	Q	.	.	.	.
19.396	0.1903	0.05	Q	.	.	.	.
19.585	0.1910	0.05	Q	.	.	.	.
19.773	0.1917	0.04	Q	.	.	.	.
19.962	0.1924	0.04	Q	.	.	.	.
20.151	0.1930	0.04	Q	.	.	.	.
20.339	0.1937	0.04	Q	.	.	.	.
20.528	0.1943	0.04	Q	.	.	.	.

APPENDIX B
HYDRAULIC CALCULATIONS



JN 34358
CALTRANS STORM WATER MANAGEMENT SERVICES
I-5/MANCHESTER EAST EXTENDED DETENTION BASIN
BASIN DESIGN AND VOLUME CALCULATIONS

INTERNATIONAL						IMPERIAL			
LOCATION	BASE AREA	DEPTH	TOP SURFACE AREA	VOLUME		DEPTH	AREA	VOLUME	
	m^2	m	m^2	m^3		FT	FT^2	FT^3	AC-FT
4.573	176.9572	0	176.957	0	BASIN INVERT	0.00	1903.776	0	
		0.1	206.408	19.16825		0.33	2220.617	676.4005104	0.02
		0.2	235.858	41.28155		0.66	2537.458	1456.724762	0.03
		0.25	250.584	53.44259		0.82	2695.878	1885.858291	0.04
		0.34	277.089	77.18786		1.12	2981.035	2723.7706	0.06
		0.4	294.759	94.34331		1.31	3171.139	3329.14449	0.08
5.000	302.711	0.427	302.711	102.4092		1.40	3256.686	3613.768583	0.08
		0.618	367.840	166.4467	6-MOS WQ	2.03	3957.366	5873.498205	0.13
		0.832	440.811	252.9724	1-YR WQ	2.73	4742.421	8926.775352	0.20
5.500	473.2048	0.927	473.205	296.3881		3.04	5090.927	10458.81087	0.24
		1	570.666	352.6316		3.28	6139.451	12443.506	0.29
5.788	583.2919	1.215	671.207	486.133	BASIN RIM	3.99	7221.116	17154.44178	0.39

Calc. By: _____ Date: 1/12/99
Chkd. By: _____ Date: _____
Backchkd. By: _____ Date: _____

JN 34358
CALTRANS STORMWATER MANAGEMENT SERVICES
I-5/MANCHESTER AVE EXTENDED DETENTION BASIN
6- MONTH Orifice Sizing Calculation

Note: Orifice Sizing Calculation based on procedure for 40 hour drawdown time in Caltrans Storm Water Quality Handbooks Planning and Design Staff Guide. September 1997, PD11B(1) Detention Basin, pg. 6 of 12.

a = area of orifice (ft^2)
$a = (7x10^{-5}) \times A \times (H-Ho)^{0.5} / CT$

A = Average surface area of the pond (ft^2)
A = 2,931 ft^2
6-Month H = Elevation when the pond is full (ft)
H = 2.03 ft
Ho = Final Elevation when pond is empty (ft)
Ho = 0.00 ft
C = Orifice Coefficient
C = 0.66 for thin materials
T=Drawdown time of full pond (hrs)
T= 72

a = 0.0061 ft^2 Total area required
a = 0.0031 ft^2 Area of each orifice (Two orifices required.)

d = diameter of orifice = $(4 \times a / \pi)^{0.5}$
d = 0.06 ft
d = 0.75 in = 19.1 mm

6-MOS. **Use d = .75 in (19.1mm) for each orifice to ensure a 72 hour drawdown tim**

Informational Calculations:

T (hrs)	a (ft^2)	d (in)
48	0.0092	1.30
72	0.0061	1.06

Calc. By: _____ Date: 1/12/99
Chkd. By: _____ Date: _____
Backchkd. By: _____ Date: _____

JN 34358
CALTRANS STORMWATER MANAGEMENT SERVICES
I-5/MANCHESTER AVE EXTENDED DETENTION BASIN
1-YEAR Orifice Sizing Calculation

Note: Orifice Sizing Calculation based on procedure for 40 hour drawdown time in Caltrans Storm Water Quality Handbooks Planning and Design Staff Guide, September 1997, PD11B(1) Detention Basin, pg. 6 of 12.

a = area of orifice (ft^2)

$a = (7x10^{-5}) \times A \times (H-Ho)^{0.5} / CT$

A = Average surface area of the pond (ft^2)

A = 3,323 ft^2

1-YR H = Elevation when the pond is full (ft)

H = 2.73 ft

Ho = 6-Month Water Surface Elevation (ft)

Ho = 2.03 ft

C = Orifice Coefficient

C = 0.66 for thin materials

T=Drawdown time of full pond (hrs)

T= 72

a = 0.0041 ft^2 Total area required

a = 0.0021 ft^2 Area of each orifice (Two orifices required.)

d = diameter of orifice = $(4 \times a / \pi)^{0.5}$

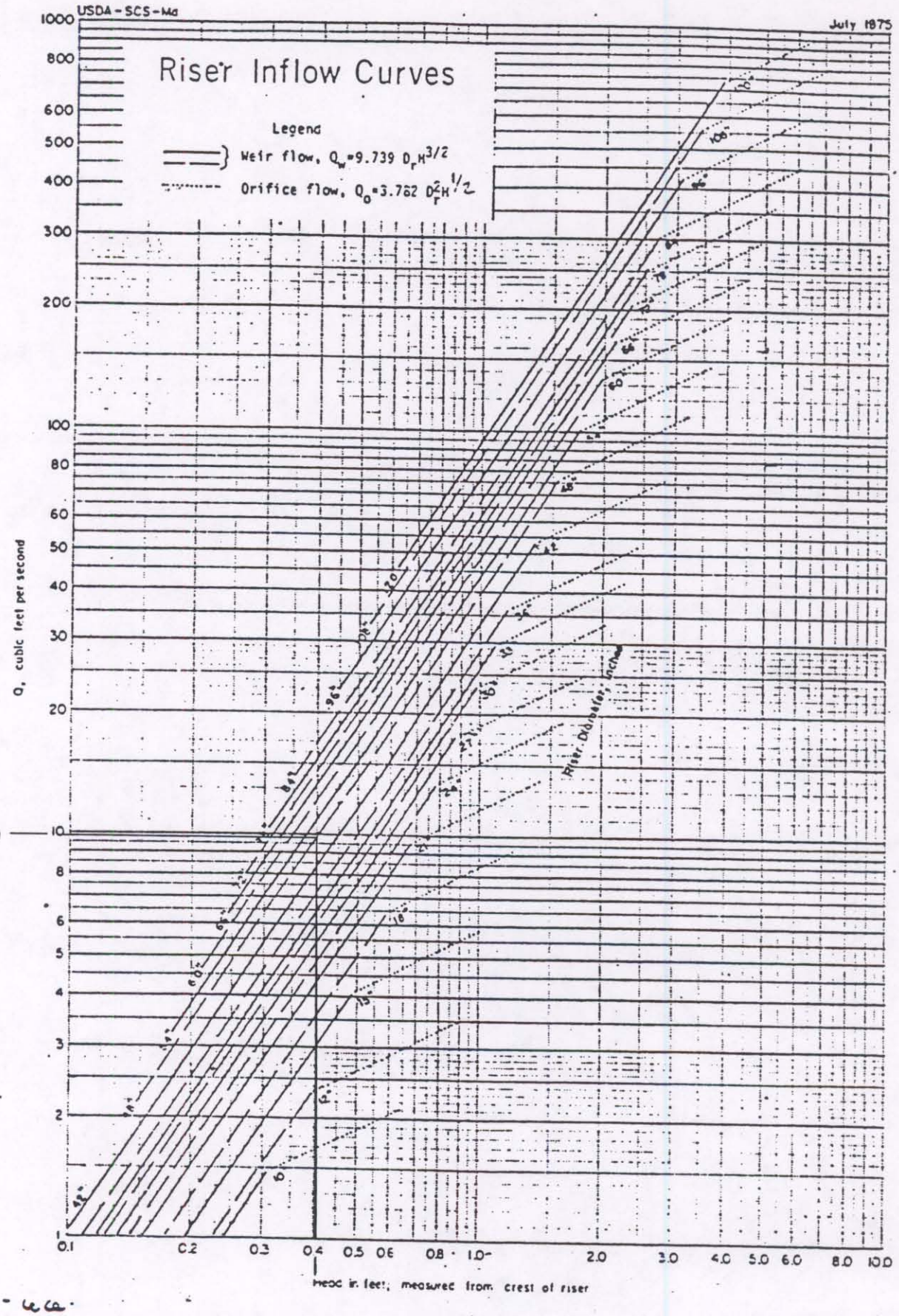
d = 0.05 ft

d = 0.61 in = 15.6 mm

1-YEAR **Use d = 0.61 in (15.6mm) for each orifice to ensure a 72 hour drawdown tir**

Informational Calculations:

T (hrs)	a (ft^2)	d (in)
48	0.0062	1.06
72	0.0041	0.87


USDA - SCS - Md
July 1975
Riser Inflow Curves
Legend
Weir flow, $Q_w = 9.739\ D_r H^{3/2}$
Orifice flow, $Q_o = 3.782\ D_r^2 H^{1/2}$
Q, cubic feet per second
Riser Diameter, inches
Head in feet, measured from crest of riser
1000
800
600
500
400
300
200
100
80
60
50
40
30
20
10
8
6
5
4
3
2
1
0.1
0.2
0.3
0.4
0.5
0.6
0.8
1.0
2.0
3.0
4.0
5.0
6.0
8.0
10.0

$Q_{25} = 9.7$

APPENDIX C
HYDROLOGY MAP

APPENDIX D

HYDROSEED MIX RECOMMENDATIONS

CALTRANS STORM WATER MANAGEMENT - BMP RETROFIT PILOT PROGRAM

DESIGN DIRECTIVE MEMORANDUM NO. 6

To:	William Wiedenbacher, Montgomery Watson	Fax No. (619) 239-3895
	Gary Friedman, Montgomery Watson	Fax No. (619) 239-3895
	Glen Grant, Montgomery Watson	Fax No. (209) 547-9344
	Robert Finn, Brown and Caldwell	Fax No. (714) 474-0940
	Douglas Robison, Brown and Caldwell	Fax No. (714) 474-0940
	Ceazar Aguilar, AEI CASC	Fax No. (909) 783-0108
	Erwin Fogerson, AEI CASC	Fax No. (909) 783-0108
From:	Mike Chesney, RBF	
Copies to:	Steve Borroum, Caltrans HQ	Scott Taylor, RBF MS 140
	Kim Noonan, Caltrans HQ	Tom Ryan, RBF MS 140
	Pete Van Riper, Caltrans District 7	Bruce Cooke, RBF MS 210
	Cid Tesoro, Caltrans District 11	Rhonda Tijerina, RBF MS 210
	Christian Herencia, Caltrans District 11	Scott Sawyer, MS 425
	Yulya Davidova, Caltrans District 11	Nicole Walker, RBF MS 420
	Michael Reader, LKR Group	Ann Walker, RBF MS 140
	Steve Huff, RBF MS 425	Sal Sheikh, RBF MS 400
Date:	March 11, 1998	
Subject:	**DESIGN ISSUES AND DIRECTIVES**	

Please incorporate the following design directives/elements into your BMP designs:

1. The suggested seed mix for landscaping all exposed/graded areas (excluding the biofiltration strips and swales), and the infiltration basins is as follows:

Botanical Name	Common Name	lbs/acre
Trifolium Willdenovii	Tomcat Clover	3
Vulpia Microstachys	Zorro Grass	5
Lotus Scoparius	Deerweed	3
Hordeum Californicum	California Barley	10
Hordeum Vulgare	Barley	9
Eschschoizia Californica	California Poppy	2
Lupinus Bicolor	Miniature Lupine	4
Nassella Pulchra	Purple Needlegrass	4
Bromus Carinatus "Cucamonga"	Brome Grass	2
Encelia Californica	California Encelia	2

2. As stated previously, the suggested seed mix for the vegetated biofiltration swales and strips is as follows:

   - Trifolium Willdenovii (botanical name), Tomcat Clover (common name) used at 25 lbs/acre.

3. Refugio Dominguez of District 7 stated on Wednesday, March 11, 1998 that the specifications for the District 7 projects being designed by Montgomery Watson and Brown and Caldwell will not require a Traffic Handling section. Refugio stated the District will prepare the traffic handling specifications in-house. The consultants must still prepare traffic handling/stage construction plans.

4. Enclosed you will find RBF's design package with most of the design elements and plan types required. Additionally, we are including RBF's preliminary specifications package for use as a guideline.

Please call me at (714) 855-5792 should you have any comments, questions, or require any additional information.

Martha Blane & Associates
Habitat Restoration Consulting

May 12, 1998

Bill Whittenberg
RBF & Associates
14725 Alton Parkway
Irvine, CA 92618

Project: Caltrans Storm Water Management - Retrofit Pilot Study

Subject: Planting Recommendations for Bio-Filter Strips

Dear Bill:

In response to your request, enclosed herein is information on candidate plant species for planting within the bio-filter strips. Per our discussions and the background information you provided, the species chosen must perform certain functions and meet specific criteria, as follows:

- Filter suspended solids within runoff from paved areas
- Withstand one-year storm events
- Adapt to climate conditions within Caltrans Districts 7 and 11
- Tolerate periods of both high and low moisture
- Be low-growing
- Require little or no maintenance

Species that meet these criteria are shown on Table 1 (attached), along with information on plant life form, height, origin, beneficial/detrimental characteristics and comments. *Trifolium willdenovii* (tomcat clover), which was recommended previously by others, is also included on Table 1 for the purpose of comparison.

Leguminous plant species were researched because of their ability to add nitrogen to soils. Few legume species are available that meet the criteria listed above, particularly adaptability (i.e., drought tolerance) and low maintenance (most are annuals that may require replanting). To obtain some benefit from the use of nitrogen-fixing species, it is recommended that annual leguminous species be planted initially, but without expectation for natural reseeding.

P.O. Box 4093 • San Marcos, CA 92069 • Phone: (760) 471-1245 • Fax: (760) 471-7671

In order to increase the likelihood of adequate plant cover in the shortest possible time, while fulfilling the criteria above, it is recommended that a mixture of species be planted together. This approach is also beneficial in reducing the potential for damage from diseases and pests that could occur with a one-species, monoculture type planting.

A recommended mixture of species for planting within the bio-filter strips is shown on Table 2 (attached). The table shows the preferred planting method, material application rates for seeds and container plant densities for plants.

The availability of suitable plant species grown as sod was researched. None of the species shown in Table 1 or 2 are grown as sod since there is not an established market for them and most species are not sod forming. It may be possible to request that some species be contract grown (e.g., saltgrass and creeping wildrye) as sod. However, even if a grower agreed to grow sod, there is high risk for failure since it is not a usual practice.

The plant material that can be obtained in a sod-like form is saltgrass. It is grown in flats (±18" x 18") and may be purchased at Tree of Life Nursery in San Juan Capistrano (714.728.0685). However, as shown in Table 2 and described above, planting "plugs" from cut-up flats, along with other species, is recommended.

All seed and plant materials should be ordered well in advance of need to ensure availability. For example, Tree of Life Nursery currently has ±15 flats of saltgrass available. They indicated that it takes about three months (during the warm season) to grow a flat of saltgrass. The needlegrass species are also currently available, but, availability changes on a daily basis.

Per your request, the seed/plant mixture shown on Table 2 was compared to the seed mix presented in Design Directive Memorandum No. 6 (March 11, 1998) to determine which would be more appropriate for general erosion control. Of the two choices, I believe the seed mix shown in Memo. No. 6 would be the better choice. The reason for this is that there are two shrub species included, along with several grass species and a few legumes. The shrubs are the primary difference, and they will add greater diversity in stature, root system, and possibly the longevity of the plantings.

If you need information on other plant mixtures/assemblages, additional lists could be developed. Please contact me with any questions or comments and/or if you would like further assistance.

Sincerely,

Martha Blane

Martha Blane

Attachments: Table 1
Table 2
References and Sources of Information

TABLE 1
PLANT SPECIES SUITABLE FOR BIO-FILTER PLANTINGS

Genus species	Common Name	Life Form	Height	Origin/Range
Bromus carinatus	California brome	grass, perennial, short-lived (± 2 years)	18" - 36"	Western US, British Columbia to Central America
Deschampsia caespitosa	Tufted hairgrass	grass, perennial, clumping	12" - 30"	North America
Distichlis spicata	Saltgrass	grass, perennial, rhizome/stolon forming	6" - 20"	North America to South America
Elymus glaucus	Blue wildrye	grass, perennial, clumping	18" - 36"	Alaska to Baja California
Hordeum brachyantherum	Meadow barley	grass, perennial, clumping	12" - 18"	North America to Baja California
Leymus triticoides "Rio"	Creeping wildrye	grass, perennial, creeping rhizomes	18" - 36"+	Western US and Baja California
Lupinus bicolor	Pygmy-leaf lupine	legume, annual	4" - 12"	California deserts, mountains and coastal areas
Nasella lepida	Foothill needlegrass	grass, perennial, clumping	12" - 24"	Northern California to Baja California
Nasella pulchra	Purple needlegrass	grass, perennial, clumping	12" - 24"	Northern California to Baja California
Trifolium willdenovii	Tomcat clover	legume, annual	4" - 16"	Western North America

TABLE 1
(Continued)

Genus species	Common Name	Benefits	Detriments	Comments
Bromus carinatus	California brome	Fast-growing, adapted to drought and poor soils.	Short-lived, may be too tall	Often used for soil stabilization and revegetation.
Deschampsia caespitosa	Tufted hairgrass	Grows in dense stands, adapted to moist soils, recovers well from disturbance.	May be too tall, too dense and require too much moisture.	Important range species, widely distributed, sometimes used for erosion control.
Distichlis spicata	Saltgrass	Stout, hardy, adapts to harsh soil conditions (wet or dry) and silt build-up, recovers well from disturbance.	Foliage may turn brown during coldest months.	Spreads by creeping stolons (similar to Bermuda grass in appearance, but not as vigorous), can form a tough mat-like cover.
Elymus glaucus	Blue wildrye	Fast-growing, fast-spreading, good for erosion control.	May be too tall.	Foliage is bluish-green.
Hordeum brachyantherum	Meadow barley	Fast-growing, begins spring growth early, tolerates moist soils.	May be short-lived.	Can provide cover while slower-growing species become established.
Leymus triticoides "Rio"	Creeping wildrye	Tolerates harsh conditions, heavy soils, forms a dense ground cover, long-lived.	May be too tall and too dense.	Stays green late into summer.
Lupinus bicolor	Pygmy-leaf lupine	Nitrogen-fixing, adapts to many soils, germinates early.	Annual, may not reseed if other vegetation is present.	Frequently included in erosion control and revegetation seed mixes.
Nasella lepida	Foothill needlegrass	Adapted to drought and poor/disturbed soils, long-lived, low fuel.	Best in well-drained soils.	Common component of California grasslands; often used for revegetation.
Nasella pulchra	Purple needlegrass	Adapted to drought and poor/disturbed soils, long-lived, low fuel.	Best in clayey soils.	Major component of California grasslands; often used for revegetation.
Trifolium willdenovii	Tomcat clover	Nitrogen-fixing, adapts to heavy soils, germinates early.	Annual, may not reseed.	Seed recently became available for erosion control and revegetation plantings.

TABLE 2
RECOMMENDED SPECIES MIXTURE FOR BIO-FILTER PLANTINGS[1]

Genus species	Common Name	Seed Application Rate Per Acre %Purity/%Germination	Container Plant Spacing and Container Size/Type
Bromus carinatus	California brome	6.0 pounds per acre 95/80	--
Distichlis spicata	Saltgrass	--	12" on-center spacing of "plugs" from cut-up flats
Deschampsia caespitosa	Tufted hairgrass	1.0 pound per acre 80/60	--
Hordeum brachyantherum	Meadow barley	5.0 pounds per acre 90/80	--
Lupinus bicolor	Pygmy-leaf lupine	3.0 pounds per acre 98/80	--
Nasella lepida	Foothill needlegrass	--	12" on-center spacing of groove tubes (2" deep x 3/4" wide)
Nasella pulchra	Purple needlegrass	--	12" on-center spacing of groove tubes (2" deep x 3/4" wide)
Trifolium willdenovii	Tomcat clover	1.5 pounds per acre 95/75	--

1. Seed and container plant recommendations based on which material will provide the most reliable and fastest cover. Some container species are also available as seed.

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APPENDIX E
ENGINEERING COST ESTIMATES

ENGINEER'S ESTIMATE

Item	Item Description	Quantity	Unit	Unit Cost	Cost
100	CONSTRUCTION AREA SIGNS	LUMP SUM	LS	LUMP SUM	3,500.00
101	TRAFFIC CONTROL SYSTEM	LUMP SUM	LS	LUMP SUM	3,500.00
102	CHANNELIZER (SURFACE MOUNTED)	12	EA	50.00	600.00
103	TRAFFIC PLASTIC DRUMS	15	EA	50.00	750.00
104	TEMPORARY RAILING (TYPE K)	184	M	35.00	6,440.00
105	TEMPORARY CRASH CUSHION MODULE	16	EA	300.00	4,800.00
106	REMOVE DRAINAGE FACILITIES	LUMP SUM	LS	LUMP SUM	2,500.00
107	CLEARING AND GRUBBING	LUMP SUM	LS	LUMP SUM	3,000.00
108	ROADWAY EXCAVATION	1880	M^3	12.00	22,560.00
109	CONCRETE BACKFILL	10	M^3	200.00	2,000.00
110	EROSION CONTROL (TYPE D)	2.3	HA	5000.00	11,500.00
111	CLASS 2 AGGREGATE BASE	72	M^3	30.00	2,160.00
112	ASPHALT CONCRETE (TYPE A)	47	TONN	45.00	2,115.00
113	MINOR CONCRETE (MINOR STRUCTURE)	35	M^3	1100.00	38,500.00
114	450 MM ALTERNATIVE PIPE CULVERT	177	M	200.00	35,400.00
115	600 MM ALTERNATIVE PIPE CULVERT	63	M	300.00	18,900.00
116	450 MM REINFORCED CONCRETE PIPE	177	M	200.00	35,400.00
117	600 MM REINFORCED CONCRETE PIPE	63	M	300.00	18,900.00
118	450 MM CORRUGATED STEEL PIPE (3.51 MM THICK)	1	M	300.00	300.00

119	1200 MM CORRUGATED STEEL PIPE (3.51 MM THICK)	2	M	600.00	1,200.00
120	CANAL GATE	1	EA	10000.00	10,000.00
121	PALMER-BOWLUS FLUME	1	EA	3000.00	3,000.00
122	900 MM PRECAST CONCRETE PIPE RISER	4.5	M	1800.00	8,100.00
123	ROCK SLOPE PROTECTION (BACKING NO. 2, METHOD B)	40	M^3	100.00	4,000.00
124	SLOPE PAVING (CONCRETE)	14	M^3	400.00	5,600.00
125	ROCK SLOPE PROTECTION FABRIC	101	M^2	5.00	505.00
126 (F)	MISCELLANEOUS IRON AND STEEL	1780	KG	10.00	17,800.00
127	1.8 M CHAIN LINK GATE (TYPE CL-1.8)	1	EA	800.00	800.00
128	OBJECT MARKER (TYPE L)	1	EA	50.00	500.00
129	MOBILIZATION	LUMP SUM	LS	LUMP SUM	26,433.00
				SUBTOTAL CONTRACT ITEMS	290,763.00
				5% CONTINGENCY	14,538.00
				GRAND TOTAL	305,301.00

(F) Denotes Final Pay Item